A VIEW OF MT. RAINIER WITH THE TACOMA NARROWS BRIDGE IN THE FOREGROUND. PHOTO BY WSDOT.

Risk Report

FEMA Region X – Pierce County, Washington

Unincorporated Areas of Pierce County; Cities of Auburn, Bonney Lake, Buckley, DuPont, Eatonville, Edgewood, Fife, Fircrest, Gig Harbor, Lakewood, Milton, Orting, Pacific, Puyallup, Roy, Sumner, Tacoma, and University Place; and Towns of Carbonado, Ruston, South Prairie, Steilacoom, and Wilkeson

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Executive Summary

This Risk Report discusses risk for the unincorporated areas of Pierce County (Unincorporated Pierce County); the Cities of Auburn, Bonney Lake, Buckley, DuPont, Edgewood, Fife, Fircrest, Gig Harbor, Lakewood, Milton, Orting, Pacific, Puyallup, Roy, Sumner, Tacoma, University Place, and Wilkeson; and the Towns of Carbonado, Ruston, South Prairie, and Steilacoom. The Muckleshoot, Nisqually, and Puyallup Tribes, which have lands within Pierce County, were not included in this assessment as sufficient data were not available. A Risk Report has two goals: (1) inform communities of their risks related to natural hazards, and (2) enable communities to act to reduce their risk. State and local officials can use the data provided in this Risk Report to update a variety of local plans; communicate risk; inform the modification of development standards; identify mitigation projects; and, ultimately, take action to reduce risk.

This Risk Report showcases the results of an in-depth risk assessment for flood, earthquake, landslide, lahar (volcanic mudflow), and tsunami hazards in Pierce County performed by a Federal Emergency Management Agency (FEMA) project team in support of the Risk Mapping, Assessment, and Planning (Risk MAP) program. The project team used the risk assessment, which analyzes how a hazard affects the built environment, population, and local economy as the basis for developing resilience strategies and identifying resilience actions. The risk assessments in this report were completed using the) free FEMA risk assessment tool, Hazus, which estimates losses to a flood and/or earthquake for specific buildings. The project team incorporated a complete list of the buildings in Pierce County into the Hazus model using information provided by Pierce County. The team assessed the risk of landslide, volcano, and tsunami hazards by performing a vulnerability assessment. Information the team collected to assess potential community losses included local assets or resources at risk from certain hazards, the physical features and human activities that contribute to that risk, and the location and severity of the hazard. The loss data from Hazus and the exposure analysis highlight areas that would be more severely affected, which provides an opportunity for State and local officials to prioritize mitigation actions in these areas.

Flood Risk Assessment

Based on the flood risk assessment performed for Pierce County, the project team modeled flood losses at $39.1 million. At 15.51 percent, the team determined that the City of Orting has the largest percentage of improved parcels (parcels with buildings) located in the Special Flood Hazard Area (SFHA). The SFHA is the area subject to inundation by the base (1-percent-annualchance) flood. The team determined that the unincorporated areas of Pierce County have the highest loss ratio at 11.3 percent, and the largest total estimated losses at just under $31 million. As a result of a FEMA Risk MAP project, the communities have received new Flood Insurance Rate Map (FIRM) panels and 1-percent-annual-chance depth grids.

Earthquake Risk Assessment

Based on the earthquake risk assessment performed for Pierce County, the project team modeled earthquake building losses at $2.5 billion. The team completed the earthquake assessment for a Magnitude (M)7.1 earthquake event on the Tacoma fault, as an M7.1 earthquake event will cause the most damage to Pierce County. For the City of Gig Harbor, the community closest to the fault line, the project team modeled $185.1 million in building and content damage and a loss ratio of 12.3 percent. For the Town of Ruston and the Cities of Fife, Milton, Pacific, Roy, and Sumner, the team has estimated loss ratios of more than 5 percent. For railway and port facilities, the team has estimated loss ratios of

more than 20 percent. Collectively, the team estimated transportation system losses as close to $600 million, with $455 million of that due to bridge damage.

Landslide Risk Assessment

Based on the landslide risk assessment performed for Pierce County, the project team determined that six communities have some identified landslide risk: Towns of Eatonville and Steilacoom; Cities of Gig Harbor, Tacoma, and University Place; and unincorporated areas of Pierce County. A more comprehensive landslide analysis will be needed for the entire county to better understand the landslide risk. Based on the land risk assessment, the project team estimates that the unincorporated areas of Pierce County have the largest building values in landslide hazard areas at $464.7 million. As a percentage, the Town of Steilacoom has the largest portion of improved parcels in a landslide zone at 7.3 percent.

Tsunami Risk Assessment

Based on the tsunami risk assessment, the project team determined that over 1,500 improved parcels, with building values over $1.2 billion, in five communities are at risk from a tsunami generated by an M7.2 Seattle fault earthquake. The Cities of Tacoma and Fife have the highest building values ($577 million and $530 million, respectively) that intersect the tsunami zone. The City of Fife is the community with the largest percentage (30.7 percent) of improved parcels that lie within a tsunami zone.

Volcano Risk Assessment

Based on the volcano risk assessment, the project team determined that a Mount Rainier volcanic eruption could impact nearly $7.1 billion in improved parcels. For three communities, the Town of Carbonado and the Cities of Fife and Orting, 100 percent of essential facilities and structures are located in the volcanic areas. The team determined that the Cities of Fife and Sumner each would have over $1.3 billion in losses. The team determined that the largest total building value impacted would be in the City of Puyallup, with just over $2 billion in losses and 50 percent of the city's improved parcels being impacted.

Risk Assessment Conclusion

The results of this risk assessment, including the loss data from Hazus, the exposure analysis, and design code analyses, highlight areas affected by the hazards noted above. State and local officials should use this information to identify areas for mitigation projects as well as areas where additional outreach efforts to educate Pierce County residents on hazards may be needed. The areas of greatest hazard impact are identified in Section 9, Areas of Mitigation Interest and Recommended Mitigation Strategies, and serve as a starting point for State and local officials in identifying and prioritizing actions each community can take to reduce its risks.

1. Introduction

This Risk Report summarizes the risk assessment results and findings from a Federal Emergency Management Agency (FEMA) study performed in support of the Risk Mapping, Assessment, and Planning (Risk MAP) program. All results, databases, and maps used to generate this Risk Report are provided in the Risk Assessment Database included with this report. State and local officials can reduce each community's risk to natural hazards by using the summary information provided in this Risk Report, in conjunction with the data in the Risk Assessment Database, to:

- **Update local hazard mitigation plans, shoreline master plans, and community comprehensive plans** – Planners can use risk information to develop and/or update hazard mitigation plans, comprehensive plans, future land use maps, and zoning regulations. For example, zoning codes can be changed to provide for more appropriate land uses in high-hazard areas.
- **Update emergency operations and response plans** – Emergency managers can use the information in this Risk Report to identify low-risk areas for potential evacuation and sheltering. Risk assessment information may show vulnerable areas, facilities, and infrastructure for which planning for continuity of operations plans, continuity of government plans, and emergency operations plans would be essential.
- **Communicate risk** – Local officials can use the information in this Risk Report to communicate with property owners, business owners, and other citizens about risks and areas of mitigation interest (AOMIs).
- **Inform the modification of development standards** – Planners and public works officials can use the information in this Risk Report to adjust development standards for certain locations.
- **Identify mitigation projects** – Planners and emergency managers can use the information in this Risk Report to determine specific mitigation projects. For example, a floodplain administrator may identify critical facilities that need to be elevated or removed from the mapped Special Flood Hazard Area (SFHA), the area subject to inundation by the base (1-percent-annual-chance) flood.

The intended audience for this report includes, but is not limited to, the following:

- Local Elected Officials
- Community Planners
- Emergency Managers
- Public Works Officials

2. Risk Assessment

A risk assessment analyzes how a hazard affects the built environment, population, and local economy. In hazard mitigation planning, risk assessments are the basis for identifying resilience strategies and actions. A risk assessment defines the hazard and enhances the decision-making process. The project team completed the risk assessments in this Risk Report using a free FEMA risk assessment tool, Hazus, which estimates flood and earthquake losses for specific buildings. The team incorporated a complete list of buildings in Pierce County into the Hazus model using information provided by Pierce County officials. The team assessed the risk of other hazards by performing a vulnerability assessment. To assess potential community losses, the team collected the following information:

- Local assets or resources at risk to the hazard
- Physical features and human activities that contribute to that risk
- Location and severity of the hazard

This report contains the following types of risk analysis to help individuals describe and visualize the risk for a variety of hazards at the jurisdictional levels:

1. Flood Risk Assessment:
   a. Coastal: Hazus Estimated Loss Information
   b. Riverine: Vulnerability Assessment
2. Earthquake Risk Assessment: Hazus Estimated Loss Information
3. Landslide Risk Assessment: Vulnerability Assessment
4. Tsunami Risk Assessment: Vulnerability Assessment
5. Lahar Risk Assessment: Vulnerability Assessment

Detailed information on the methodology used to perform the risk assessment is provided in the appendix.

3. Pierce County Risk MAP Overview

FEMA completed a countywide flood update for Pierce County which focused on updating riverine and coastal flood hazards. The FEMA Production and Technical Services provider (Strategic Alliance for Risk Reduction 2), the FEMA Community Engagement and Risk Communication provider (Resilience Action Partners), the Washington State Department of Ecology, and the Washington State Department of Natural Resources are contributing to this project. The project area is shown in Map 1.

Project Milestones

Project milestones are the estimated completion dates for key tasks or events that must be accomplished to complete a Risk MAP Project phase. They serve as progress indicators and are the basis for planning future Risk MAP meetings. However, all project milestones are subject to change due to changes in scope, delays in data acquisition, and other unforeseen complexities within a study. The Pierce County project timeline is shown in Table 1.

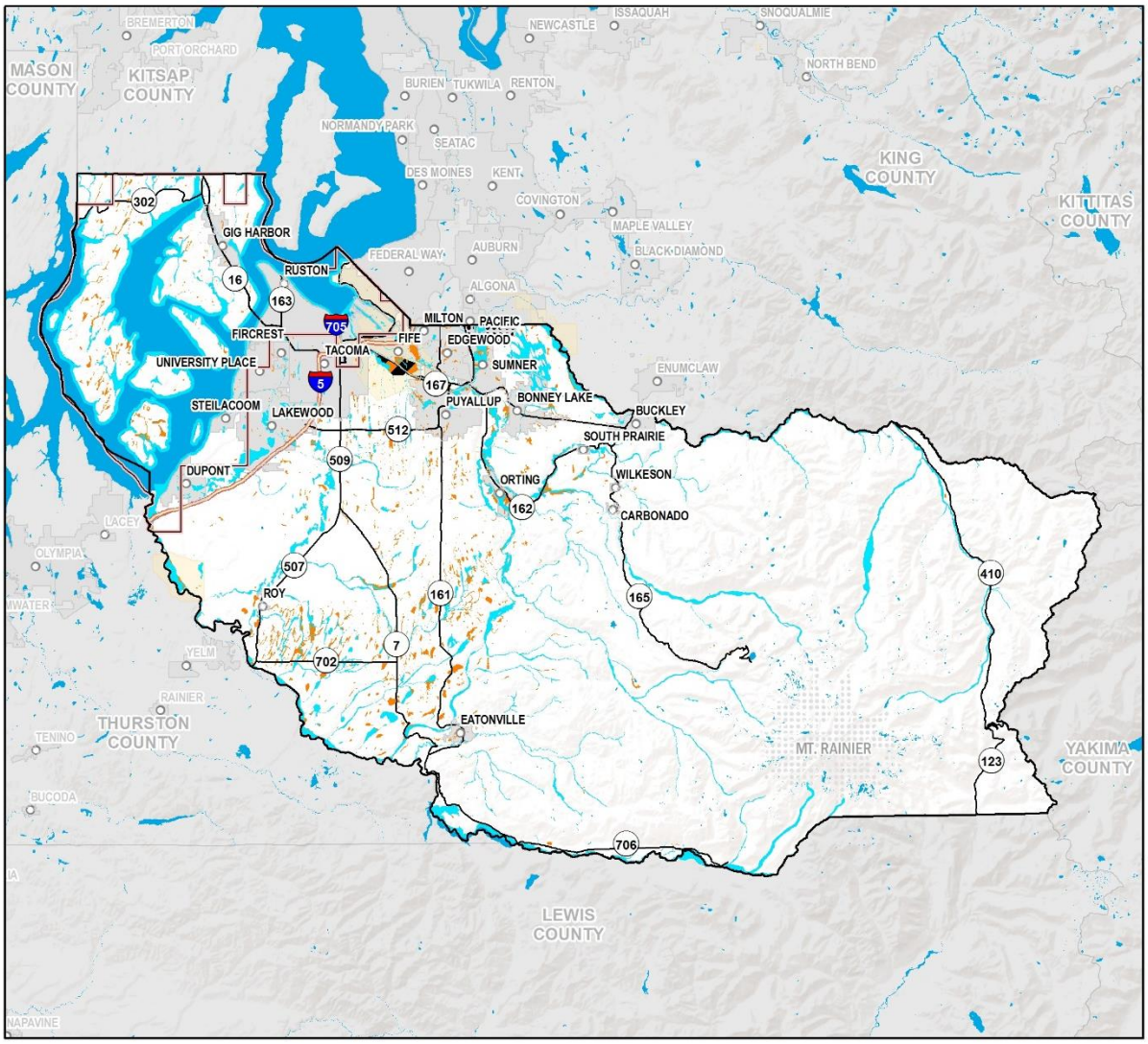
Table 1: Project Timeline

TASK NAME	PIERCE COUNTY COASTAL	PIERCE COUNTY COUNTYWIDE
Engineering Analysis	September 10, 2013	N/A
Flood Risk Review Meeting	November 18, 2013	N/A
Initial Preliminary Map	N/A	November 1, 2007
Revised Preliminary Map	December 19, 2014	
Consultation Coordination Officer Meeting	January 28, 2015	
Public Open House(s)	April 21, 22, and 29, 2015	
Appeal Period	July 2015 – October 2015	
Resilience Meeting	August 9 and 23, 2016	

TASK NAME	PIERCE COUNTY COASTAL	PIERCE COUNTY COUNTYWIDE
Letter of Final Determination	September 7, 2016	
Effective Date of Map	March 7, 2017 *projected*	

Map 1: Pierce County Project Area

PROJECT AREA



MAP SYMBOLOGY

- 0.2% ANNUAL CHANCE FLOOD HAZARD
- 1% ANNUAL CHANCE FLOOD HAZARD
- AREA PROTECTED BY LEVEE
- AREA NOT INCLUDED
- RISK REPORT AREA
- COASTAL STUDY EXTENT

ABOUT

This map displays preliminary flood hazard data.

Source data for this Risk Report was compiled from FEMA's Region X Office, FEMA's Map Service Center, USGS, and the State of Washington Department of Natural Resources. This is a non-regulatory product and is provided to your community for information gathering and sharing purposes only.

SCALE: 1 inch = 10 miles 1:633,600

SERVICE LAYER CREDITS: SOURCES: ESRI, USGS, NOAA

FEMA, the State, and the affected communities held three meetings to help empower community stakeholders and officials to address risks identified in association with this study. The three meetings are the Flood Risk Review (FRR), Consultation Coordination Officer (CCO), and Resilience Meetings. The FRR Meeting was held on November 18, 2013, after the completion of the coastal analysis task. The input data, methodology, and draft maps were presented at the FRR Meeting. The CCO meeting, the meeting at which the preliminary results of the flood study are reviewed and discussed with community officials, was held on January 28, 2015. Three public open houses were held in April 2015. Resilience Meetings were held on August 9 and 23, 2016, with a special elected officials briefing presented before the August 9 Resilience Meeting. The purpose of the Resilience Meeting is to continue to build local capacity for implementing priority mitigation activities within the project study area.

Project Scope

The Pierce County Coastal Study included the entire coastline of Pierce County. The Pierce County Countywide Study included detailed study updates to Artondale Creek, Canyon Creek, Carbon River, Clarks Creek, Clear Creek, Clover Creek, Crescent Creek, Diru Creek, East Fork of Clear Creek, Fennel Creek, Lacamas Creek, Mashel River, Meeker Ditch, Morey Creek, North Fork of Clover Creek, North Fork of Clover Creek Tributaries, Puyallup River, Rody Creek, South Prairie Creek, Spanaway Creek, Swan Creek, Wapato Creek I, Wapato Creek II, White River, and Woodland Creek. Both projects are shown on Map 1.

Additional Project Deliverables

The Pierce County Coastal Study includes Flood Risk Datasets (Changes Since Last FIRM, Flood Depth and Analyses Grids, and Flood Risk Assessment). The project team completed the Risk MAP datasets in July 2015 and the datasets are being delivered as part of this Risk Report.

4. Flood Risk Assessment

Flood Hazard Overview

FEMA created a new Flood Insurance Rate Map (FIRM) for Pierce County that included updated coastal flood modeling for the Cities of DuPont, Fife, Gig Harbor, Lakewood, Tacoma, and University Place; the unincorporated areas of Pierce County within the project area; and the Towns of Ruston and Steilacoom. New riverine flood modeling for Pierce County that was produced under the countywide study involves all incorporated communities within Pierce County, as well as the unincorporated areas of Pierce County. Of note, the Town of Carbonado has no SFHAs identified. In addition to new flood maps, flood risk assessment products were developed and used in this Risk Report. Depth grids were created for the 1-percent-annual-chance flood for the coastal areas. Depth grids were generated from the coastal flood model and show the level of flooding in feet for each pixel and each flood frequency. Depth grids were used in this risk assessment to determine which properties are affected by flooding. The 1-percent-annual-chance coastal depth grid for the Project Area is shown in Map 2.

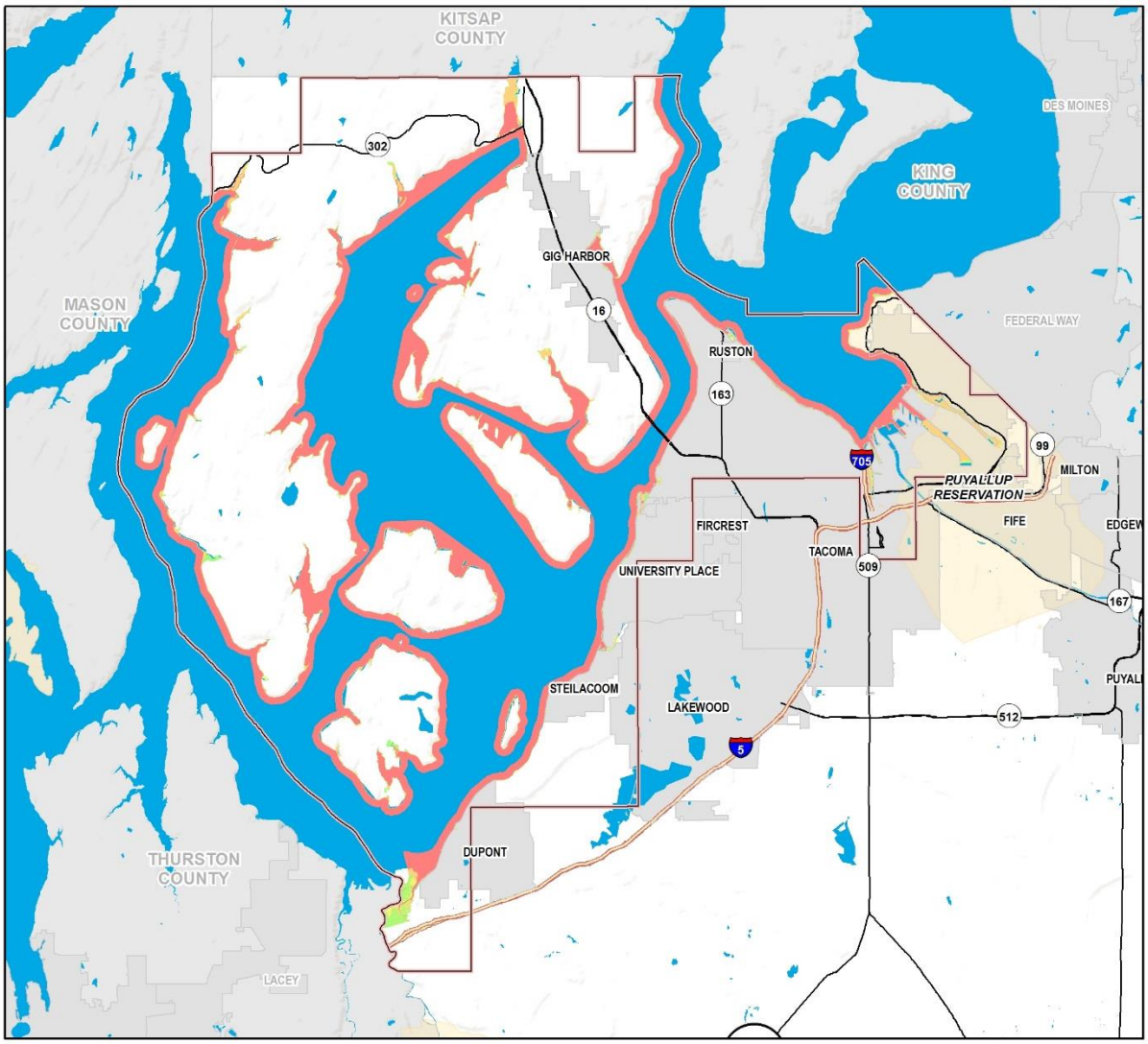
The 1-percent-annual-chance depth grid can also be used as an outreach tool to show areas affected by flood hazards. These properties would be excellent candidates for mitigation projects. Potential mitigation projects are highlighted in the individual community sections of this report. For areas not located on the coast, the project team completed a vulnerability assessment for properties in riverine floodplains.

In addition to the depth grid, the project team created a BFE+ grid that shows increases of 1, 2, and 3 feet above the Base (1-percent-annual-chance) Flood Elevation (BFE). This grid can be used to represent flood events that exceed the 1-percent-annual-chance flood. The BFE+ grid can be used to identify areas affected by increased storm surge, storms greater than the 1-percent-annual-chance event, and areas

potentially impacted by sea level rise. The BFE+ grid for the project area is shown in Map 3. Local officials can use the dataset for future land-use and comprehensive planning. This product is meant to guide local communities as they consider future risk and is not a substitute for detailed sea level rise modeling.

Map 2: 1-Percent-Annual-Chance Depth Grid (in feet) for the Coastal Project Area

FLOOD DEPTH GRID



MAP SYMBOLOGY

- FLOOD DEPTH: 3' OR LOWER
- FLOOD DEPTH: 3' TO 5'
- FLOOD DEPTH: 5' TO 10'
- FLOOD DEPTH: 10' OR HIGHER
- COASTAL STUDY EXTENT

ABOUT

This map displays coastal flood depths in a one percent annual chance flood event.

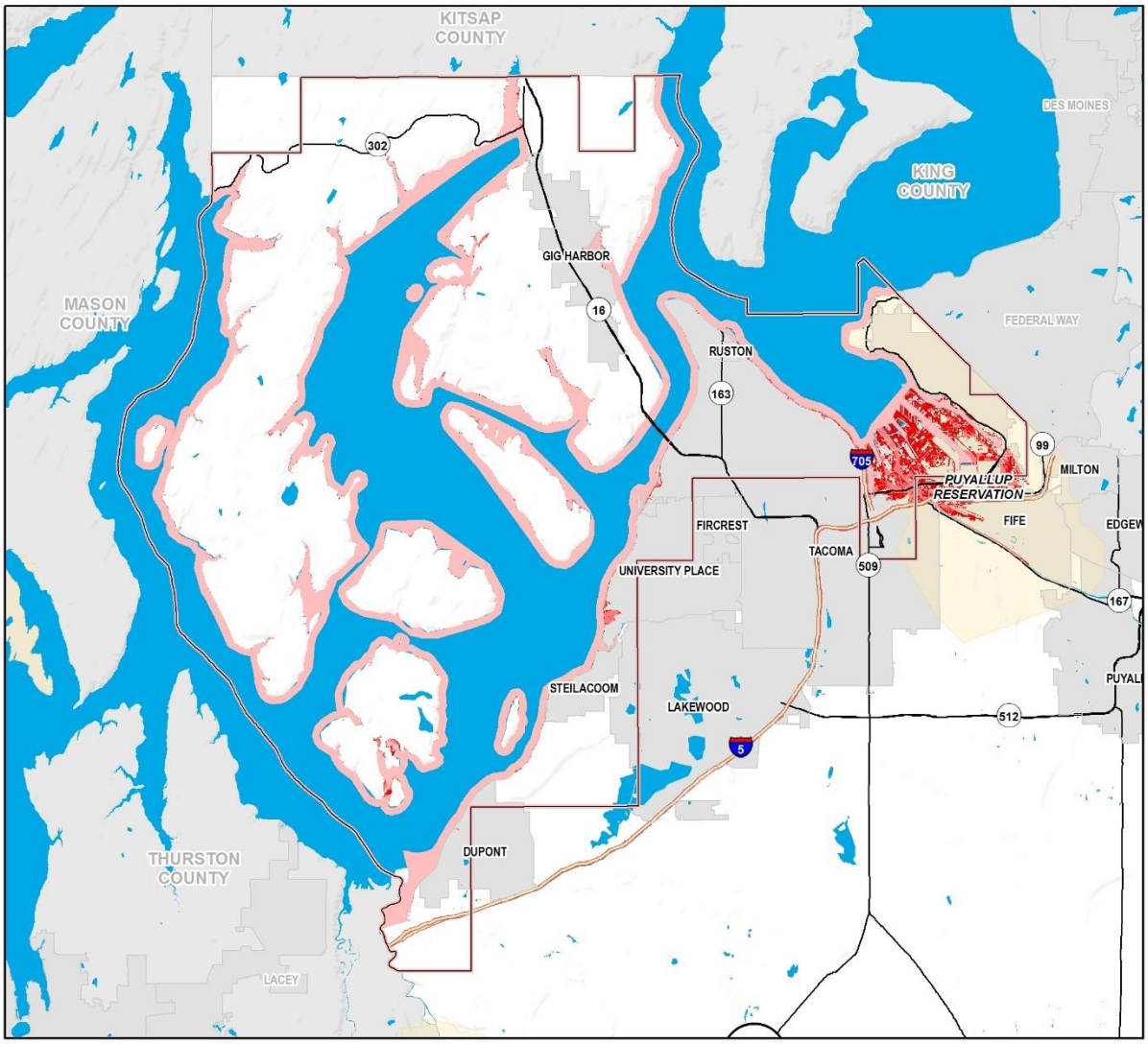
Source data for this Risk Report was compiled from FEMA's Region X Office, FEMA's Map Service Center, USGS, and the State of Washington Department of Natural Resources. This is a non-regulatory product and is provided to your community for information gathering and sharing purposes only.

SCALE: 1 inch = 4 miles 1:253,440

SERVICE LAYER CREDITS: SOURCES: ESRI, USGS, NOAA

Map 3: BFE+ 1-, 2-, and 3-Foot Grids for the Coastal Project Area

BFE+ DEPTH GRIDS



MAP SYMBOLOGY

- 1% ANNUAL CHANCE FLOOD
- 1% ANNUAL CHANCE FLOOD (+1 FOOT)
- 1% ANNUAL CHANCE FLOOD (+2 FEET)
- 1% ANNUAL CHANCE FLOOD (+3 FEET)
- COASTAL STUDY EXTENT

ABOUT

This map displays coastal flood depths in a one percent annual chance flood event and at one foot increments from the one percent annual chance base flood elevation.

Source data for this Risk Report was compiled from FEMA's Region X Office, FEMA's Map Service Center, USGS, and the State of Washington Department of Natural Resources. This is a non-regulatory product and is provided to your community for information gathering and sharing purposes only.

SCALE: 1 inch = 4 miles 1:253,440

SERVICE LAYER CREDITS: SOURCES: ESRI, USGS, NOAA

Flood Risk Assessment Overview

National Flood Insurance Program (NFIP) information for the communities covered by this risk assessment, including information on participation in the Community Rating System (CRS) and the CRS rating for the participating communities, is shown in Table 2.

Table 2: Community Characteristics in Pierce County

COMMUNITY NAME	TOTAL POPULATION	CRS COMMUNITY	FLOOD CLAIMS	REPETITIVE LOSS PROPERTIES	TOTAL POLICIES	TOTAL INSURANCE COVERAGE
Auburn, City of*	70,180	YES - 5	11	0	536	$166,662,400
Bonney Lake, City of	17,374	NO	524	2	10	$2,302,600
Buckley, City of	4,354	NO	5	0	1	$350,000
Carbonado, Town of	610	NO	0	0	0	$0
DuPont, City of	8,199	NO	0	0	0	$0
Eatonville, Town of	2,758	NO	4	2	2	$608,000
Edgewood, City of	9,387	NO	12	4	6	$1,351,000
Fife, City of	9,173	YES - 5	2	0	105	$34,030,000
Fircrest, City of	6,497	NO	33	4	12	$3,478,800
Gig Harbor, City of	7,126	NO	97	0	17	$5,191,000
Lakewood, City of	58,163	NO	18	18	10	$3,080,000
Milton, City of*	6,968	NO	2	0	8	$1,370,000
Orting, City of	6,746	YES - 5	133	0	306	$77,067,300
Pacific, City of*	6,606	NO	28	0	137	$42,198,400
Pierce County (Unincorporated Areas)	366,738	YES - 2	82	81	1,969	$530,689,500
Puyallup, City of	37,022	NO	0	15	374	$109,460,700
Roy, City of	793	NO	3	0	2	$454,100
Ruston, Town of	749	NO	0	0	0	$0
South Prairie, Town of	434	NO	2	12	15	$3,646,800
Steilacoom, Town of	5,985	NO	0	0	21	$6,181,000
Sumner, City of	9,451	NO	4	72	325	$75,610,100
Tacoma, City of	198,397	NO	0	18	152	$39,433,100

COMMUNITY NAME	TOTAL POPULATION	CRS COMMUNITY	FLOOD CLAIMS	REPETITIVE LOSS PROPERTIES	TOTAL POLICIES	TOTAL INSURANCE COVERAGE
University Place, City of	31,144	NO	0	0	9	$2,457,000
Wilkeson, Town of	477	NO	0	0	7	$2,311,000
TOTAL	**865,331**	**---**	**960**	**228**	**4,024**	**$1,107,932,800**

Note: data obtained from the 2010 US Census and FEMA Community Information System (CIS)
*multi-county community, but does include information for the entire city.

State and local officials can use the information in Table 2 to highlight communities that are already affected by flooding, including those with repetitive loss properties and flood claims. In addition, State and local officials can compare the insurance coverage to the dollar losses shown in Table 3 to determine whether enough coverage exists for a specific 1-percent-chance event.

The project team completed a flood risk assessment using Hazus 3.2 with individual structure footprints, assessor's data, and parcel data provided by Pierce County. Coastal depth grids, derived from this Risk MAP project, help provide loss estimates at a structure level where data are available. To determine loss values in coastal areas, the team incorporated only properties with buildings (improvements) on them in the analysis; the team did not assess impacts to vacant land. A coastal flood depth grid, used for the coastal assessment, is shown in Map 2. The team assigned structure centroids in the area where the structure intersects the SFHA polygon, the depth grid, and the Census tract. Detailed information on the methodology used for incorporating local data into Hazus is provided in the appendix.

The project team analyzed parcels outside the coastal study extent to show whether they intersected an SFHA. The team analyzed those parcels further by the type of SFHA they intersected. Table 3 highlights the building value and loss ratios of improved parcels located within the coastal SFHA by community. Parcels with buildings intersecting an SFHA are also summarized by community.

Table 3: SFHA Assessments in Pierce County

COMMUNITY NAME	TOTAL ESTIMATED VALUE OF IMPROVED PARCELS	TOTAL NUMBER OF IMPROVED PARCELS	IMPROVED PARCELS IN THE SFHA	PERCENT OF IMPROVED PARCELS IN THE SFHA	BUILDING DOLLAR LOSS FOR A 1% ANNUAL CHANCE COASTAL FLOOD EVENT	LOSS RATIO (LOSSES/ BUILDING VALUE)	IMPROVED PARCELS WITHIN THE VE ZONE	IMPROVED PARCELS WITHIN THE AE, A, AO, AH ZONES
Auburn, City of**	$746.3M	2,545	***	***	***	***	***	***
Bonney Lake, City of	$1.6B	6,372	16	0.25%	***	***	0	16
Buckley, City of	$345.5M	1,488	2	0.13%	***	***	0	2
Carbonado, Town of	$28.9M	228	0	0.00%	***	***	0	0
DuPont, City of[1]	$933.4M	2,981	0	0.00%	***	***	0	0
Eatonville, Town of	$181.0M	920	2	0.22%	***	***	0	2
Edgewood, City of	$830.3M	3,497	23	0.66%	***	***	0	23

COMMUNITY NAME	TOTAL ESTIMATED VALUE OF IMPROVED PARCELS	TOTAL NUMBER OF IMPROVED PARCELS	IMPROVED PARCELS IN THE SFHA	PERCENT OF IMPROVED PARCELS IN THE SFHA	BUILDING DOLLAR LOSS FOR A 1% ANNUAL CHANCE COASTAL FLOOD EVENT	LOSS RATIO (LOSSES/ BUILDING VALUE)	IMPROVED PARCELS WITHIN THE VE ZONE	IMPROVED PARCELS WITHIN THE AE, A, AO, AH ZONES
Fife, City of[1]	$1.3B	2,383	71	2.98%	***	***	0	71
Fircrest, City of	$570.3M	2,349	9	0.38%	***	***	0	9
Gig Harbor, City of[1]	$1.5B	2,903	33	1.14%	$326.7K	2.64%	9	24
Lakewood, City of[1]	$4.7B	15,327	92	0.60%	***	***	0	92
Milton, City of*	$490.7M	1,874	32	1.71%	***	***	0	32
Orting, City of	$444.7M	2,283	354	15.51%	***	***	0	354
Pacific, City of**	$71.8M	158	***	***	***	***	***	***
Pierce County (Unincorporated Areas)[1]	$26.6B	119,191	2,112	1.77%	$31.0M	11.29%	481	1,631
Puyallup, City of	$4.4B	11,233	417	3.71%	***	***	0	417
Roy, City of	$36.8M	223	0	0.00%	***	***	0	0
Ruston, Town of[1]	$86.6M	425	0	0.00%	***	***	0	0
South Prairie, Town of	$20.4M	142	10	7.04%	***	***	0	10
Steilacoom, Town of[1]	$555.8M	2,208	5	0.23%	$95.2K	9.21%	0	4
Sumner, City of	$1.3B	3,054	205	6.71%	***	***	0	205
Tacoma, City of[1]	$18.4B	64,379	109	0.17%	$6.5M	10.37%	18	91
University Place, City of[1]	$2.7B	9,336	89	0.95%	$1.1M	7.29%	68	21
Wilkeson, Town of	$26.5M	196	3	1.53%	***	***	0	3
TOTAL	**$68.0B**	**255,695**	**3,584**	**1.4%**	**$39.1M**	**10.66%**	**577**	**3,007**

Note: The total estimated value of improved parcels includes only parcels with buildings. The total estimated value of parcels is the total building and content value on that parcel. The project team estimated content value based on a percentage of the building value as defined in the Hazus model. Dollar losses are reported as well as a loss ratio, which is calculated by the total losses (including building and contents loss)/total building and contents value. Losses were only determined for those communities that have a coastal floodplain. A count of improved parcels in Zone VE, which is the 1-percent-annual-chance Coastal High Hazard Areas, as well as the improved parcels in Zones A, AE, AO, and AH, which are riverine and/or coastal 1-percent-annual-chance floodplains, is included. The loss values are for building and contents only; additional damages to infrastructure are not captured in this table.

* This is a multicounty community (only includes information for the portion of the community in Pierce County).

** This multicounty community is not included in the Pierce County flood study update; therefore, the structures at risk are unknown until a new study is completed.

*** No losses were determined because these communities are not affected by the coastal floodplain.

[1]The loss information for these communities is only for the coastal areas; riverine losses were not calculated.

Using preliminary flood hazard data in Pierce County, the project team estimated that nearly 3,600 improved parcels are in the mapped SFHA. This equates to 1.4 percent of all improved parcels (parcels with buildings) in Pierce County. Approximately 15 percent of the improved parcels are in a VE zone, also known as a Coastal High Hazard Area. The remaining parcels are in the mapped riverine or coastal SFHAs. The City of Orting has the highest percentage of improved parcels in the SFHA at 15.51 percent. The Cities of DuPont and Roy and the Town of Ruston are communities that have mapped SFHAs within their limits, but no improved parcels within the mapped SFHA. Damage from coastal flooding in Pierce County is marginal compared to other hazards. Of the nine communities residing within the coastal study extent, four communities had no projected losses. Of the five communities with reported estimated losses, the unincorporated areas of Pierce County had the largest total at around $31 million. The unincorporated areas (11.3 percent) and the City of Tacoma (10.4 percent) have the highest loss ratios of structures in the Hazus flood assessment. In total, assessed structures in coastal communities are at-risk to $39 million in flood losses.

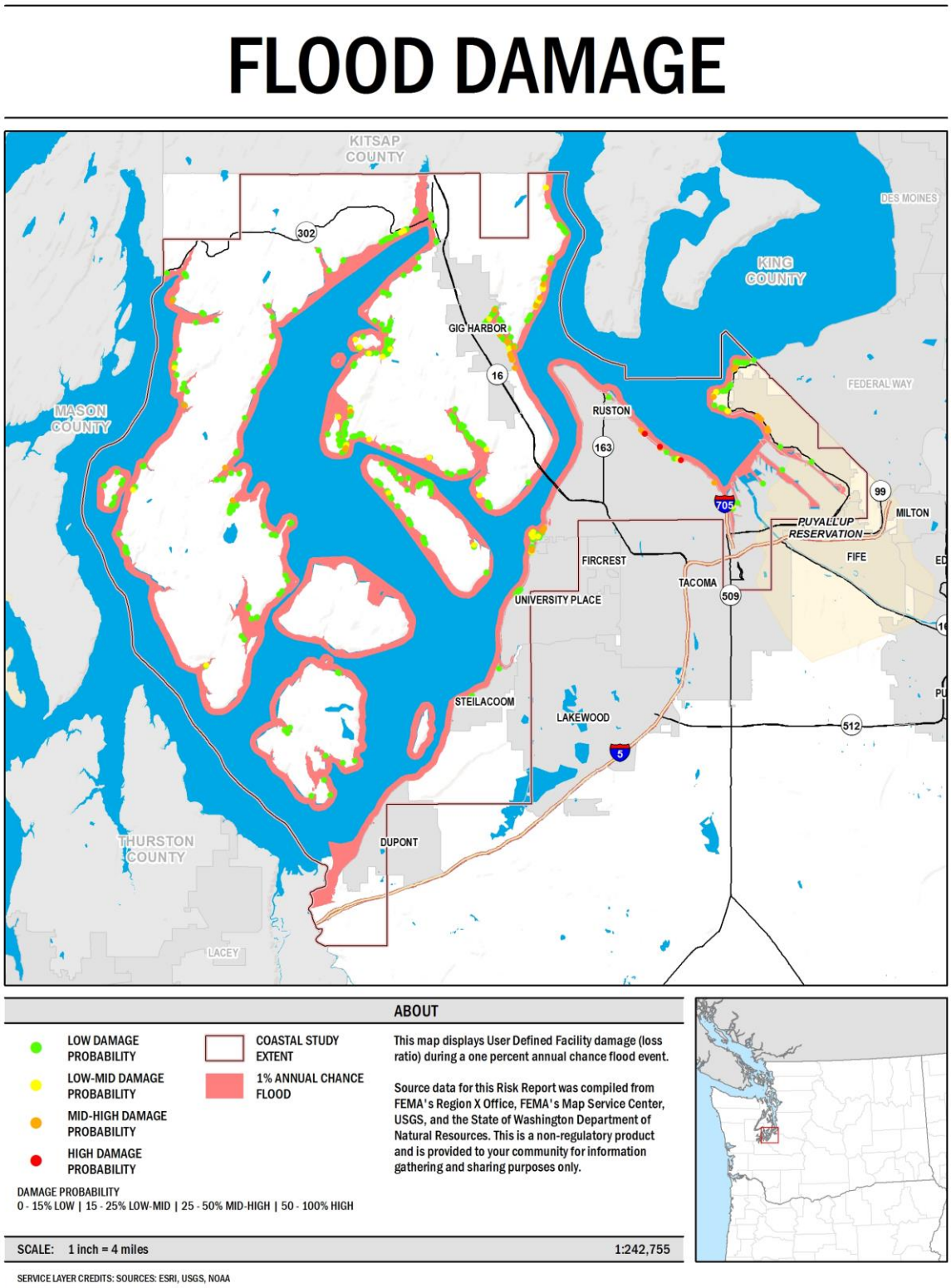
When comparing Table 3 to Table 2, the number of flood insurance policies in the county (4,024) is higher than those properties in the SFHA (3,007). The county has done an excellent job on outreach regarding flood risk, and these communities look to have a level of insurance comparable to their risk. Additional outreach could be completed to emphasize that flood insurance not only covers riverine and coastal flooding, but tsunami and possibly lahar (volcanic mudflow) as well.

The improved parcels in the VE zone are highlighted specifically because they are subject to 3 feet or more of wave inundation and are considered a high-hazard area due to the velocity impacts. For properties along the coast, the risk assessment only takes depth of water into account when calculating damage; therefore, the communities and property owners should use the loss information for improved parcels in the VE zone as a minimum because velocity impacts are not accounted for.

The community results shown above give an idea of where the largest flooding concerns are located. This risk assessment includes information for every improved parcel in each community in the SFHA, so local officials can easily determine which parcels in the community have the highest flood risk. Map 4 shows the losses (building and content by improved parcel) for a 1-percent-annual-chance event for the coastal areas of Pierce County. Improved parcels shown in red and orange have a potential to be damaged during a 1-percent-annual-chance flood event based on the depth of flooding at their location, as well as the height of the building.

The loss data from Hazus and the exposure analysis highlights those floodprone areas and local officials can used the data to identify properties for mitigation projects and additional outreach. Community-specific areas of greatest impact and potential mitigation actions are discussed in Section 9. All results, databases, and maps are provided in the Risk Assessment Database included with this Risk Report.

Map 4: Building Damage Percentage (Loss Ratio) in Pierce County



Parcels with building and contents loss are shown as having low to high damage probability. The 1-percent-annual-chance coastal floodplain is also shown. Losses were only determined for properties in the coastal floodplain.

5. Earthquake Risk Assessment

Earthquake Hazard Overview

Since earthquakes were recorded by the Puget Sound Seismic Network in 1969, the largest earthquake in Pierce County was a Magnitude 6.8 (M6.8) event on February 28, 2001, 31.66 miles below Anderson Island. This event is more commonly known as the 2001 Nisqually earthquake. The earthquake was 15.1 miles west-southwest of Tacoma and 10.5 miles northeast of Olympia. Two primary fault lines exist in the vicinity of Pierce County: the Seattle Fault and the Tacoma Fault.

The project team used an M7.1 Tacoma Fault earthquake event the basis of the earthquake risk analysis, because an earthquake of comparable magnitude struck the south Puget Sound region approximately 1,100 years ago and similar earthquakes are almost certain to occur in the future.

ShakeMaps

Maps depicting the shaking intensity and ground motion following an earthquake, called ShakeMaps, can be produced in near-real time for events or created for specific scenarios by regional seismic network operators in cooperation with the U.S. Geological Survey (USGS). State and local officials can use these ShakeMaps for response, land use, and emergency planning purposes. For this analysis, the project team used a ShakeMap reflecting the modeled M7.1 Tacoma Fault earthquake event because it could potentially cause the most damage to Pierce County. Map 5 shows the shaking intensity for this scenario. The heaviest shaking occurs just north of the county line and in areas north of Gig Harbor.

Earthquake Risk Assessment Overview

Although the project team used the modeled M7.1 Tacoma Fault earthquake event for the risk assessment in this report, additional earthquakes have been modeled that may impact other areas of the county, including the Nisqually Fault, Seattle Fault, and the Cascadia Subduction Zone Fault..

The project team completed the earthquake risk assessment using local parcel data from Pierce County, the USGS ShakeMap shown in Map 5, and liquefaction data from the Washington State Department of Natural Resources. For this study, the team incorporated individual parcel data from the county into Hazus to allow losses to be reported at the parcel level. The team incorporated only improved parcels rated into the analysis; the team did not assess impacts to vacant land. Detailed information on the methodology used to incorporate local data into Hazus is provided in the appendix. The building losses from the earthquake scenario, as well as buildings that are within a moderate-high liquefaction area, are summarized in Table 4.

Table 4: Hazus Earthquake Results for a M7.1 Tacoma Fault Earthquake Event in Pierce County

COMMUNITY NAME	TOTAL ESTIMATED VALUE OF IMPROVED PARCELS	TOTAL NUMBER OF IMPROVED PARCELS	NUMBER OF IMPROVED PARCELS IN A MODERATE OR HIGH LIQUEFACTION ZONE	PERCENT OF IMPROVED PARCELS IN MODERATE OR HIGH LIQUEFACTION ZONE	TOTAL DOLLAR LOSS FOR A TACOMA 7.1 EVENT	LOSS RATIO (LOSSES/PARCEL VALUE)
Auburn, City of*	$746.3M	2,545	53	2.1%	$35.9M	4.8%
Bonney Lake, City of	$1.6B	6,372	102	1.6%	$41.3M	2.5%
Buckley, City of	$345.5M	1,488	1,465	98.5%	$6.5M	1.9%

COMMUNITY NAME	TOTAL ESTIMATED VALUE OF IMPROVED PARCELS	TOTAL NUMBER OF IMPROVED PARCELS	NUMBER OF IMPROVED PARCELS IN A MODERATE OR HIGH LIQUEFACTION ZONE	PERCENT OF IMPROVED PARCELS IN MODERATE OR HIGH LIQUEFACTION ZONE	TOTAL DOLLAR LOSS FOR A TACOMA 7.1 EVENT	LOSS RATIO (LOSSES/PARCEL VALUE)
Carbonado, Town of	$28.9M	228	0	0.0%	$234.2K	<1%
DuPont, City of	$933.4M	2,981	0	0.0%	$8.1M	<1%
Eatonville, Town of	$180.9M	920	130	14.1%	$410.9K	<1%
Edgewood, City of	$830.3M	3,497	196	5.6%	$34.0M	4.1%
Fife, City of	$1.3B	2,383	2,376	99.7%	$71.8M	5.4%
Fircrest, City of	$570.3M	2,349	165	7.0%	$16.0M	2.8%
Gig Harbor, City of	$1.5B	2,903	0	0.0%	$185.1M	12.3%
Lakewood, City of	$4.7B	15,327	38	0.2%	$89.1M	1.9%
Milton, City of*	$490.7M	1,874	88	4.7%	$25.0M	5.1%
Orting, City of	$444.7M	2,283	2,282	100.0%	$7.4M	1.7%
Pacific, City of*	$71.8M	158	157	99.4%	$6.3M	8.7%
Pierce County (Unincorporated Areas)	$26.6B	119,191	7,024	5.9%	$844.2M	3.2%
Puyallup, City of	$4.4B	11,233	6,198	55.2%	$137.2M	3.1%
Roy, City of	$36.8M	223	0	0.0%	$153.2K	<1%
Ruston, Town of	$86.6M	425	0	0.0%	$6.0M	7.0%
South Prairie, Town of	$20.4M	142	122	85.9%	$446.8K	2.2%
Steilacoom, Town of	$555.8M	2,208	89	4.0%	$8.5M	1.5%
Sumner, City of	$1.3B	3,054	3,034	99.3%	$81.0M	6.0%
Tacoma, City of	$18.4B	64,379	830	1.3%	$826.7M	4.5%
University Place, City of	$2.7B	9,336	122	1.3%	$61.7M	2.3%
Wilkeson, Town of	$26.5M	196	3	1.5%	$333.3K	1.3%
TOTAL	**$68.0B**	**255,695**	**22,474**	**8.8%**	**$2.5B**	**3.7%**

Note: This table shows the total estimated parcel value by community, and the percentage and number of improved parcels within the high liquefaction zone. The total estimated value of improved parcels includes only parcels with buildings. The total estimated value of parcels is the total building and contents value on that parcel. Contents value was estimated based on a percentage of the building value as defined in the Hazus model. Dollar losses are reported as well as a loss ratio, which is

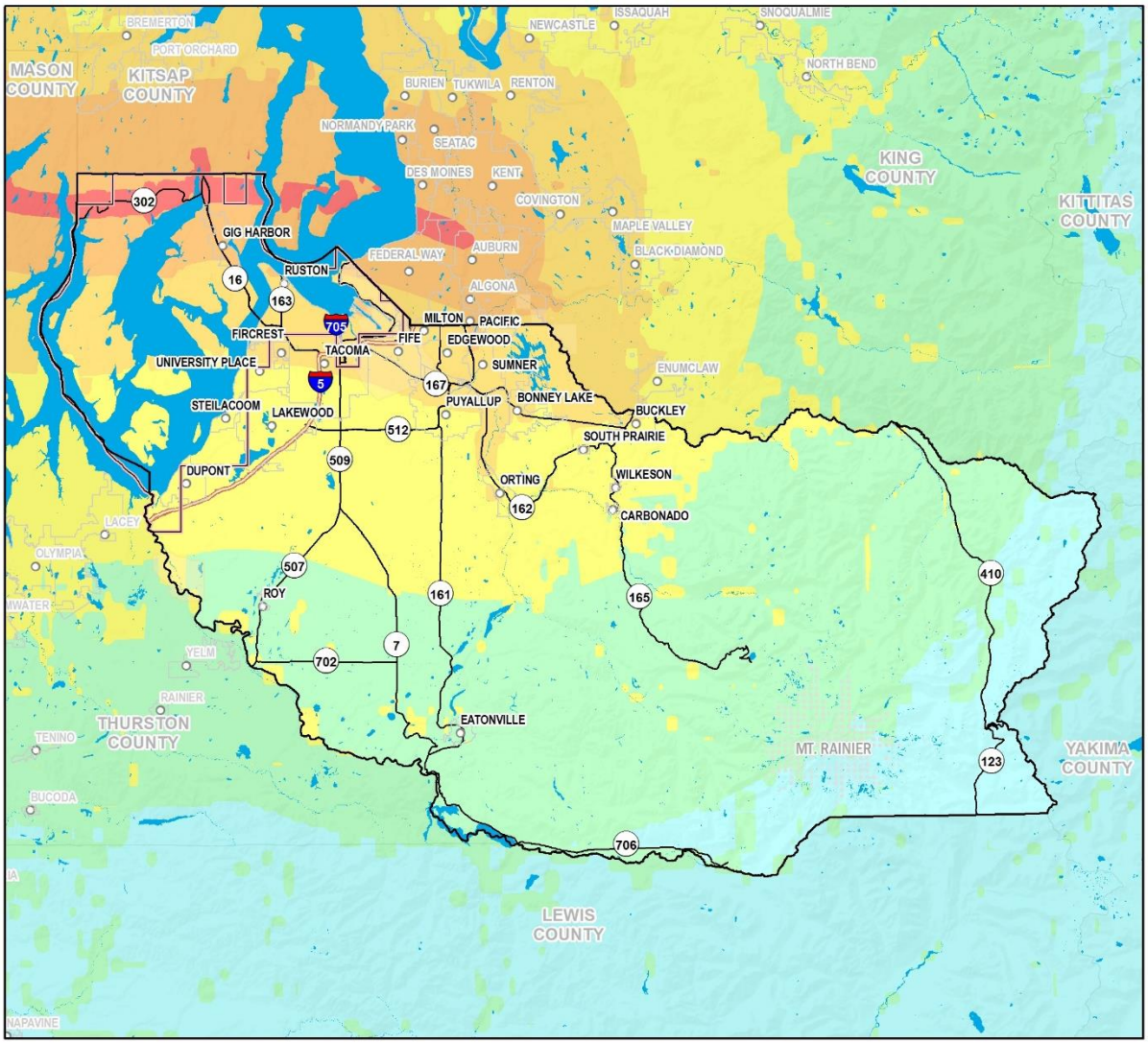
calculated by the total losses (including building and contents loss)/total building and contents value. Loss values are for a Tacoma M7.1 event.

*Multi-county community (only includes information for the portion of the community located in Pierce County).

Communities closer to the fault line have a larger loss ratio in the event of an M7.1 Tacoma Fault earthquake event. For the City of Gig Harbor, the community closest to the fault, the project team modeled a loss ratio of 12.3 percent with $185.1 million in building and content damage. On the other side of the Tacoma Narrows, the Cities of Fife, Milton, Pacific, Roy, and Sumner all have loss ratios over 5 percent. For the Cities of Fife, Pacific, and Sumner, high percentages of improved parcels in moderate to high liquefaction zones may play a pivotal role in contributing to higher loss ratios. In regard to total dollar loss, the unincorporated areas of Pierce County and the City of Tacoma have the highest values. The unincorporated areas accounted for over $844 million in projected total dollar loss, whereas the team projected the City of Tacoma to have a total dollar loss of $826 million. Across the entire county, the team projected a 3.7-percent loss ratio valued at almost $2.5 billion. Hazus also estimated the potential number of injuries and casualties for the event, which varies based on the time of day it occurs. The number of people requiring hospitalization ranges from 32 to 146, depending on a daytime or nighttime event. The number of casualties expected ranges from 3 to 33 depending on a daytime or nighttime event. Many of these injuries would occur in older structures, which would suffer severe damage during an earthquake.

Map 5: USGS ShakeMap of a Magnitude 7.1 Tacoma Fault Earthquake Scenario for Pierce County

SHAKEMAP



MAP SYMBOLOGY

EXPECTED INTENSITY

IV	LIGHT
V	MODERATE
VI	STRONG
VII	VERY STRONG
VIII	SEVERE
IX	VIOLENT

ABOUT

This map displays instrumental intensity during a Magnitude 7.1 Tacoma Fault Earthquake.

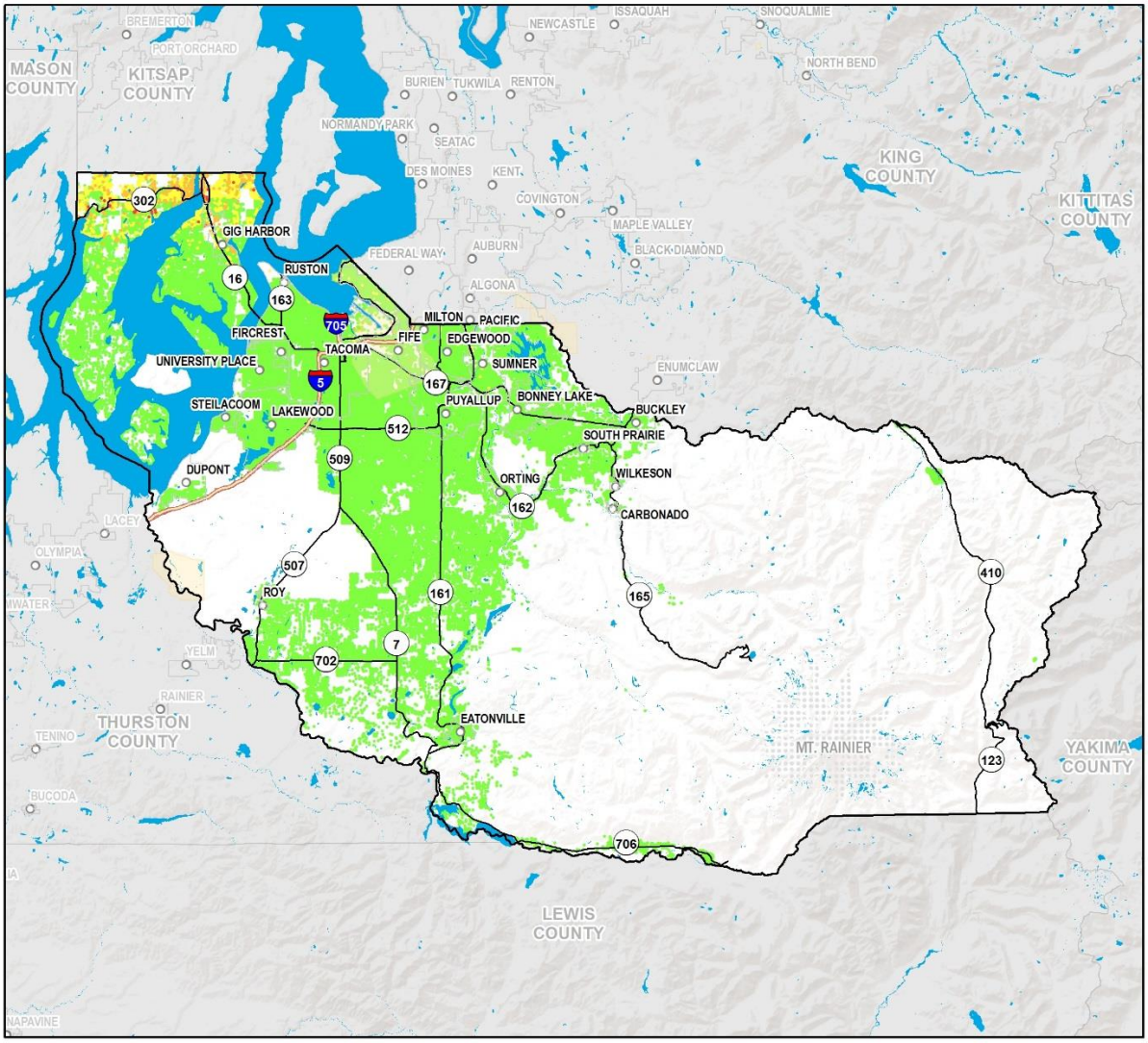
Source data for this Risk Report was compiled from FEMA's Region X Office, FEMA's Map Service Center, USGS, and the State of Washington Department of Natural Resources. This is a non-regulatory product and is provided to your community for information gathering and sharing purposes only.

SCALE: 1 inch = 10 miles 1:633,600

SERVICE LAYER CREDITS: SOURCES: ESRI, USGS, NOAA

Map 6: Building and Contents Damage Percentage (Loss Ratio) in Pierce County

EARTHQUAKE DAMAGE



Parcels with building and contents loss are shown as having a low to high damage probability.

Transportation and Utility Assessment

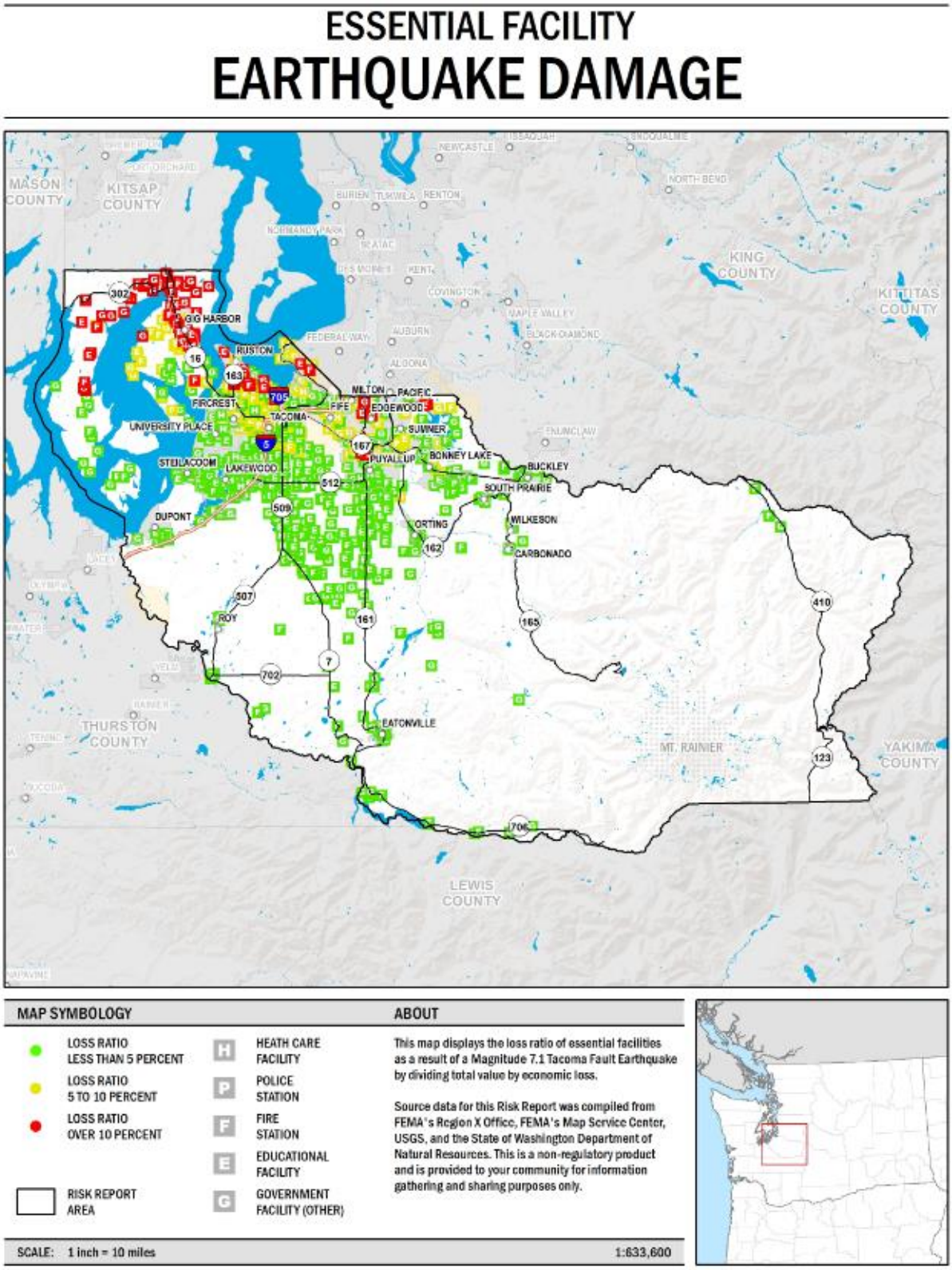
Hazus also provides an analysis on transportation systems. Transportation systems include highways, railways, light rail, bus, ports, ferry, and airports. The project team took the transportation information from the original Hazus database. The team did apply local updates; therefore, the number of facilities could vary greatly from what exists in the county. Table 5 provides an overview of transportation system damage and losses in the event of an M7.1 Tacoma Fault earthquake event, summarized at the county level.

Table 5: Transportation System Impacts for M7.1 Tacoma Fault Earthquake Event in Pierce County

TRANSPORTATION SYSTEM	COMPONENT	LOCATIONS / SEGMENTS	MODERATE DAMAGE OR GREATER	FUNCTIONALITY		INVENTORY VALUE	ECONOMIC LOSS	LOSS RATIO
				After Day 1	After Day 7			
Highway	Segments	477	0	477	477	$5.8B	$83.8M	1.5%
	Bridges	404	12	393	401	$8.2B	$455.4M	5.2%
	Tunnels	1	0	1	1	$1.2M	$20.0K	1.6%
Railway	Segments	210	0	210	210	$301.6M	$3.4M	1.1%
	Bridges	12	0	12	12	$1.5M	$10.0K	<1%
	Facilities	21	0	21	21	$55.9M	$12.4M	22.1%
Light Rail	Segments	9	0	9	9	$34.8M	$310.0K	<1%
	Facilities	9	0	9	9	$24.0M	$4.1M	17.3%
Bus	Facilities	5	0	5	5	$6.0M	$1.1M	18.7%
Ferry	Facilities	4	0	4	4	$5.3M	$960.0K	18.0%
Port	Facilities	59	0	59	59	$117.8M	$20.0M	25.4%
Airport	Facilities	4	0	4	4	$42.6M	$5.6M	13.1%
	Runways	4	0	4	4	$151.9M	$0	0.0%
TOTAL		**1,219**	**12**	**1,208**	**1,216**	**$15.2B**	**$597.0M**	**3.9%**

Each transportation system maintains relative functionality after Day 1, and almost all systems are 100 percent functional by Day 7. However, varying degrees of economic loss to systems were projected for the M7.1 Tacoma Fault earthquake event. Railway and port facilities are at greatest risk. Both have estimated loss ratios over 20 percent. In regard to total dollars, bridges are most affected. An estimated $455 million loss is estimated during an earthquake. Collectively, losses to transportation systems are estimated at close to $600 million, which is a loss ratio of 3.9 percent.

Map 7: Essential Facility Earthquake Damage in Pierce County



Building Code Analysis

State and local officials can use the loss data from Hazus and the design level analysis to highlight the buildings and areas impacted by earthquakes and they can use that information to identify properties for mitigation projects, as well as areas for additional outreach. Community-specific areas of greatest impact and potential mitigation actions are discussed in Section 9.

The project team completed an analysis to identify how many buildings were built to a specific building code. Homes built prior to 1975 are considered pre-code because there was no statewide requirement to include seismic provisions in the building code. Those built after 1975 are considered moderate code. At that time, all Washington jurisdictions were required to adhere to provisions of the most recently adopted version of the Uniform Building Code (UBC) (Noson et. al., 1988). The 1988 UBC and later statewide adoptions of the UBC and International Building Code provisions may have been integrated into local building codes on slightly different dates than the dates shown below, but the information can be used as a general planning tool until more information on the local code can be acquired.

High loss ratios during earthquake events are typically attributed to the number of pre-code buildings in each community. Because of their age and pre-code status, these buildings will not perform as well in an earthquake. The Cities of Fircrest and Lakewood have the highest number of pre-code buildings with 72.6 and 70.2 percent, respectively. The City Sumner, with 44,835 improved parcels, and the City of Tacoma, with 28,458 improved parcels, have the largest number of pre-code buildings.

Table 6: Pre-Code and Moderate Code Buildings in Pierce County

COMMUNITY NAME	TOTAL PRE-CODE PARCELS	PERCENT PRE-CODE PARCELS	TOTAL MODERATE CODE PARCELS	PERCENT MODERATE CODE PARCELS	TOTAL NUMBER OF PARCELS
Auburn, City of*	5	0.2%	2,540	99.8%	2,545
Bonney Lake, City of	861	13.5%	5,511	86.5%	6,372
Buckley, City of	752	50.5%	736	49.5%	1,488
Carbonado, Town of	127	55.7%	101	44.3%	228
DuPont, City of	126	4.2%	2,855	95.8%	2,981
Eatonville, Town of	306	33.3%	614	66.7%	920
Edgewood, City of	1,920	54.9%	1,577	45.1%	3,497
Fife, City of	563	23.6%	1,820	76.4%	2,383
Fircrest, City of	1,706	72.6%	643	27.4%	2,349
Gig Harbor, City of	663	22.85	2,240	77.2%	2,903
Lakewood, City of	10,757	70.2%	4,570	29.8%	15,327
Milton, City of*	895	47.8%	979	52.2%	1,874
Orting, City of	473	20.7%	1,810	79.3%	2,283

COMMUNITY NAME	TOTAL PRE-CODE PARCELS	PERCENT PRE-CODE PARCELS	TOTAL MODERATE CODE PARCELS	PERCENT MODERATE CODE PARCELS	TOTAL NUMBER OF PARCELS
Pacific, City of*	81	51.3%	77	48.7%	158
Pierce County (Unincorporated Areas)	4,991	44.4%	6,242	55.6%	11,233
Puyallup, City of	91	40.8%	132	59.2%	223
Roy, City of	244	57.4%	181	42.6%	425
Ruston, Town of	69	48.6%	73	51.4%	142
South Prairie, Town of	1,123	50.9%	1,085	49.1%	2,208
Steilacoom, Town of	1,500	49.1%	1,554	50.9%	3,054
Sumner, City of	44,835	69.6%	19,544	30.4%	64,379
Tacoma, City of	28,458	23.9%	90,733	76.1%	119,191
University Place, City of	4,773	51.1%	4,563	48.9%	9,336
Wilkeson, Town of	122	62.2%	74	37.8%	196
TOTAL	**105,441**	**41.2%**	**150,254**	**58.8%**	**255,695**

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

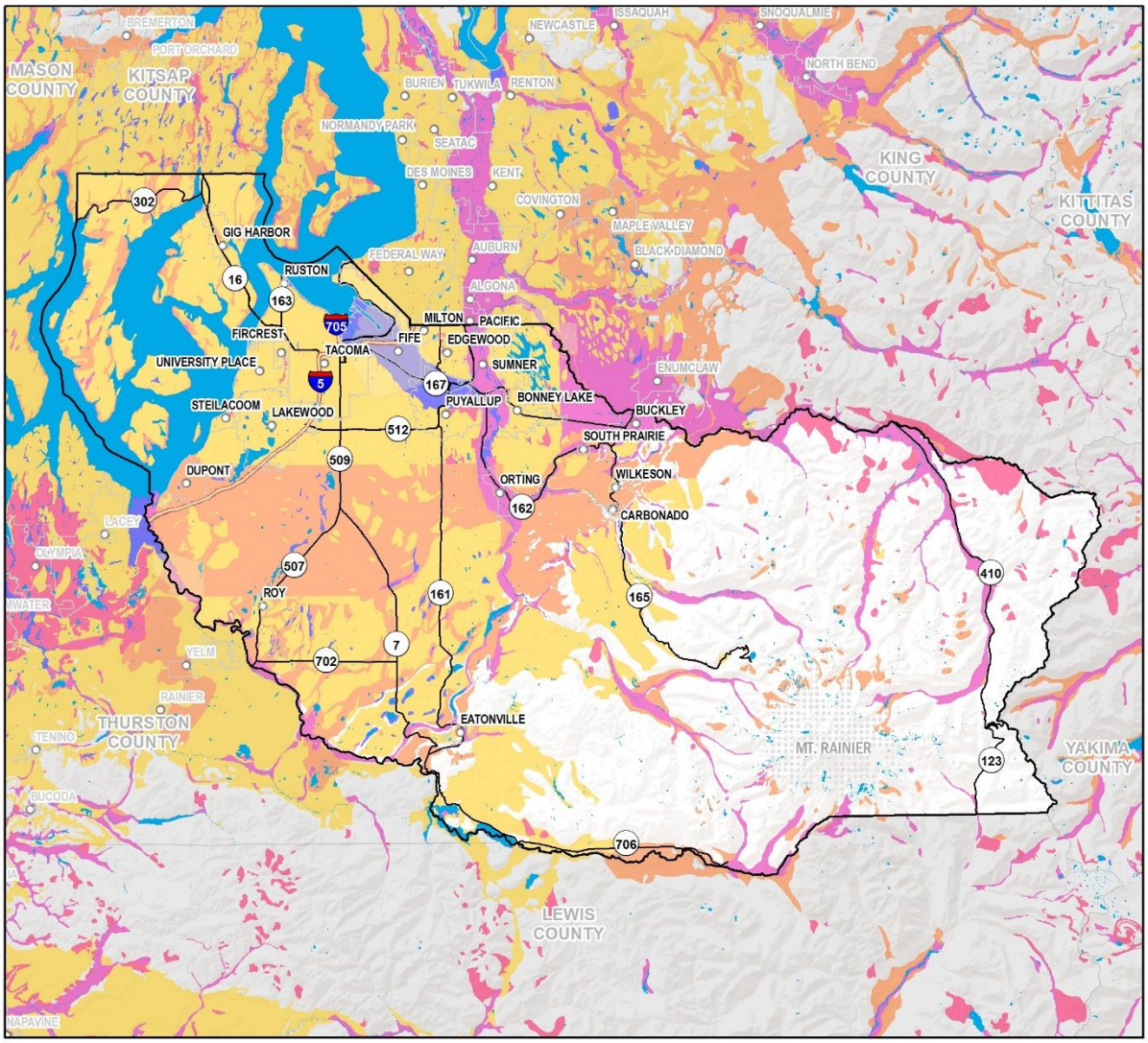
*Multi-county community (only includes information for the portion of the community located in Pierce County).

Liquefaction

Loose sand and silt that is saturated with water can behave like a liquid when shaken by an earthquake. Liquefaction susceptibility describes the likelihood of sediments to liquefy, resulting in permanent ground deformations. The looser the soils, the more likely they are to liquefy. A value of 0 indicates no liquefaction susceptibility for that area (bedrock), 1 is very low, 2 is low, 3 is moderate, 4 is moderate to high, and 5 indicates a high liquefaction susceptibility (Palmer and others, 2004). Map 8, which shows the liquefaction susceptibility for the entire project area, is significant because it shows large areas of the Cities of Fife, Orting, Puyallup, and Sumner, and the unincorporated areas of Pierce County that are in a moderate to high-liquefaction area. Earthquakes in these areas can cause greater damage to buildings. Buildings in the moderate to high liquefaction zones are highlighted in Table 4.

Map 8: Liquefaction Susceptibility in Pierce County

LIQUEFACTION



MAP SYMBOLOGY

- VERY LOW LIQUEFACTION RISK
- LOW LIQUEFACTION RISK
- MODERATE LIQUEFACTION RISK
- MODERATE TO HIGH LIQUEFACTION RISK
- HIGH LIQUEFACTION RISK
- RISK REPORT AREA

ABOUT

This map displays liquefaction risk where soil loses strength during earthquake shaking.

Source data for this Risk Report was compiled from FEMA's Region X Office, FEMA's Map Service Center, USGS, and the State of Washington Department of Natural Resources. This is a non-regulatory product and is provided to your community for information gathering and sharing purposes only.

SCALE: 1 inch = 10 miles 1:633,600

SERVICE LAYER CREDITS: SOURCES: ESRI, USGS, NOAA

6. Landslide Risk Assessment

Landslide Hazard Overview

Landslides pose a regular risk in Washington State. Landslides are caused by various reasons including extended rainfall, earthquakes, water-level changes, human activities, or basic geologic composition. In Washington State, the number of landslide events range from several hundred to a few thousand according to the Washington State Department of Natural Resources (WADNR). The unpredictable nature of landslides results in human fatalities and damage to infrastructure and personal property, and it poses severe consequential environmental impacts and drastic changes to the landscape.

Landslides are typically categorized into two types: shallow landslides and deep-seated landslides. Shallow landslides are also commonly known as mudslides and typically occur in the winter months. They move quicker than deep-seated landslides and are usually a result of extended rainfall. In a partnership with the National Oceanic and Atmospheric Administration (NOAA) and the National Weather Service, Washington WADNR monitors conditions that could produce shallow landslides. Landslide warning information can be viewed at https://fortress.wa.gov/dnr/protection/landslidewarning/.

Deep-seated landslides are much larger than shallow landslides and can occur at any time of the year. Soil degradation can happen over years, decades, and centuries with little to no warning to people above ground. The most notable and deadliest deep-seated landslide event in the United States was SR 530 (also known as the Oso Landslide) that took the lives of 43 people in Oso, Washington, in 2014.

Landslide Risk Assessment

For this risk assessment, the project team compared improved parcels to the geographic extent of the available landslide hazard area. The team obtained landslide hazard data from the Washington State Division of Geology and Earth Resources (2014); the data is compiled from four features:

1. 1:24,000-scale Landslides from Geologic Mapping
2. 1:100,000-scale Landslides from Geologic Mapping
3. Landslide Compilation (from various projects focused on landslide mapping outside of Washington State)
4. Salish Sea Landforms

Map 9 shows where landslide hazard areas have been identified in Pierce County. For the purpose of this risk assessment, the project team combined the four available landslide hazard layers into one landslide hazard layer and intersected with improved parcels to assess landslide risk. The landslide mapping used for this assessment is for the entire State of Washington, so this information should be used at that scale. Detailed landslide assessments have likely not occurred for many areas and the risk identified here could underestimate the actual landslide risk.

Table 7 provides the improved parcel value (in dollars) for each community with landslide hazard areas. Table 7 also includes the number of improved parcels in the landslide zone, as well as the total number of improved parcels and improved parcel values.

Table 7: Parcel Improvement Exposure Associated with Landslide Areas

COMMUNITY NAME	TOTAL ESTIMATED VALUE OF IMPROVED PARCELS	IMPROVED PARCEL VALUE IN LANDSLIDE ZONE	TOTAL NUMBER OF IMPROVED PARCELS	TOTAL NUMBER OF IMPROVED PARCELS IN A LANDSLIDE ZONE	PERCENTAGE OF IMPROVED PARCELS IN A LANDSLIDE ZONE
Eatonville, Town of	$181M	$4.1K	920	17	1.8%
Gig Harbor, City of	$1.5B	$7.1M	2,903	7	<1%
Pierce County (Unincorporated Areas)	$26.6B	$464.7M	119,191	1,371	1.2%
Steilacoom, Town of	$555.8M	$58.2M	2,208	161	7.3%
Tacoma, City of	$18.4B	$83.1M	64,379	185	<1%
University Place, City of	$2.7B	$44.3M	9,336	134	1.4%
TOTAL*	**$50.0B**	**$661.6M**	**196,034**	**1,875**	**<1%**

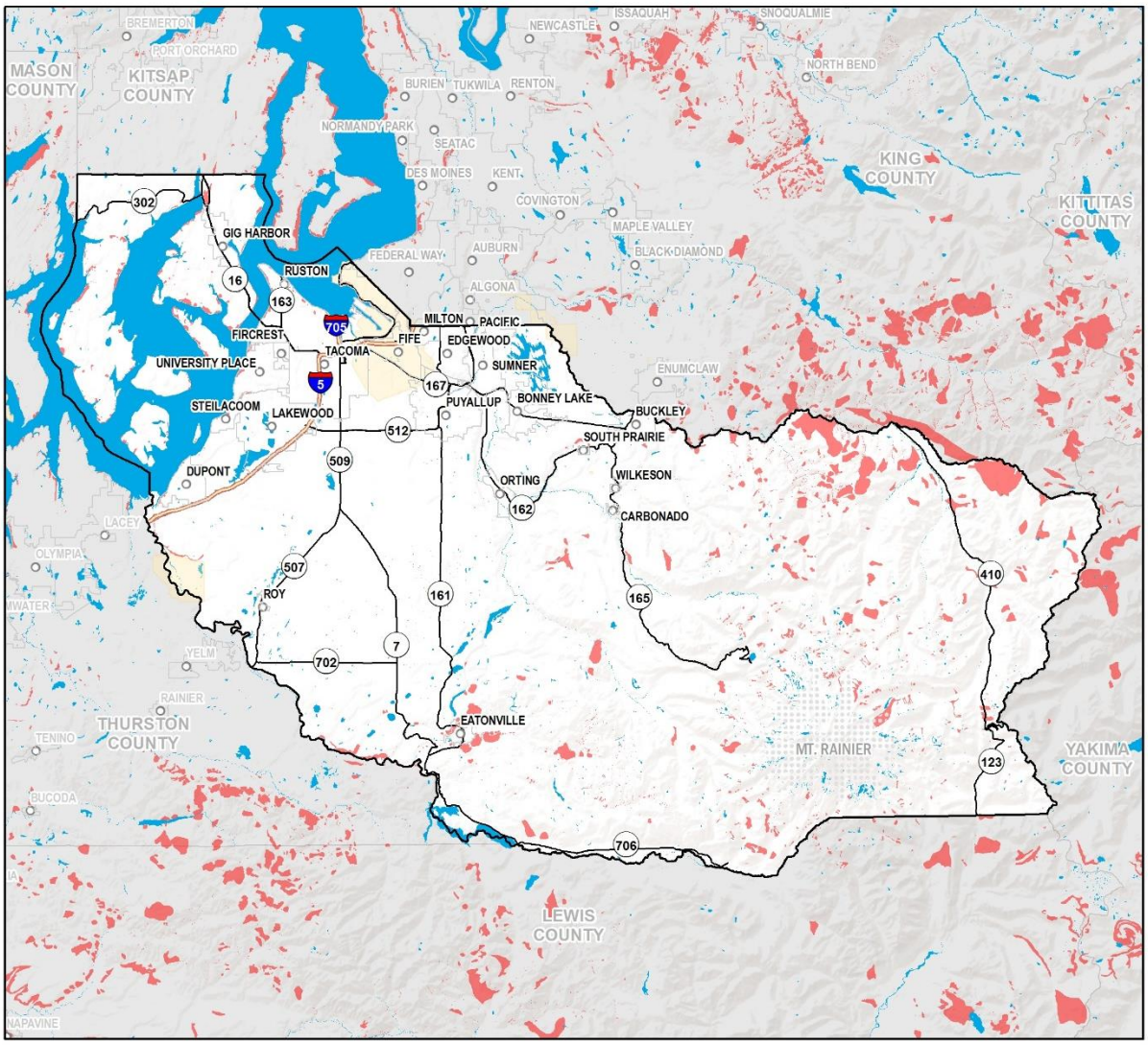
Note: The table above only includes communities that were identified as having a landslide risk based on the statewide maps. Other communities may have risk, but it is not captured in this report.

The landslide assessment for Pierce County results in six communities having some identified landslide risk to improved parcels. Although the remaining communities are shown as having no risk, this may not be the case. A more comprehensive landslide analysis will be needed for the entire county to better understand the landslide risk. In total, 1,874 improved parcels have some identifiable landslide risk. The unincorporated areas of Pierce County have the largest values in landslide hazard areas, at over $464 million. As a percentage, the Town of Steilacoom has the largest portion of improved parcels in a landslide area at 7.3 percent.

Local officials can use the landslide inventory assessment to identify properties for mitigation projects as well as areas for additional outreach. Community-specific areas of greatest impact and potential mitigation actions are discussed in Section 9. All results, databases, and maps are provided in the Risk Assessment Database included with this Risk Report.

Map 9: Landslide Hazards in Pierce County

LANDSLIDE



MAP SYMBOLOGY

LANDSLIDE RISK

RISK REPORT AREA

ABOUT

This map displays landslide risk (where analysis is readily available).

Source data for this Risk Report was compiled from FEMA's Region X Office, FEMA's Map Service Center, USGS, and the State of Washington Department of Natural Resources. This is a non-regulatory product and is provided to your community for information gathering and sharing purposes only.

SCALE: 1 inch = 10 miles 1:633,600

SERVICE LAYER CREDITS: SOURCES: ESRI, USGS, NOAA

7. Tsunami Risk Assessment

Tsunami Hazard Overview

Tsunamis are generated when geologic events, such as earthquakes or landslides, cause large, rapid movements in the sea floor that displace the water column above. That swift change creates a series of high-energy waves that radiate outward like pond ripples. Offshore tsunamis can strike adjacent shorelines in minutes and cross the ocean at speeds as great as 600 miles per hour to strike distant shores.

Washington State is at risk from tsunamis generated from submarine earthquakes both local and abroad. Along the Washington State coastline, a distant earthquake and corresponding tsunami can cross the Pacific Ocean and cause considerable damage. Tsunamis can also be generated within the Puget Sound region. In 935 A.D., a tsunami caused from an earthquake along the Seattle Fault left deposits along the shoreline and up local waterways (Walsh, T. J. et al., 2009). A similar Seattle fault earthquake today would generate 2-meter waves (approximately 6.5 feet) and inundate the Puyallup delta.

The tsunami model for Pierce County is based on a Seattle Fault M7.2 earthquake. The Method of Splitting Tsunami model developed by Titov and Gonzalez (1997) was used by the NOAA Center for Tsunami Research to develop tsunami scenarios for the region. The Seattle M7.2 tsunami scenario simulates an event similar to the last known Seattle fault earthquake that occurred 1,000 years ago (Venturato and others, 2007). Results of this scenario were published in 2009.

Tsunami Risk Assessment

In the event of an M7.2 Seattle Fault earthquake event, initial flooding from a tsunami would occur 5 minutes after the initial shaking. Tsunami inundation is typically categorized in three depth ranges: 0 to 0.5 meter, 0.5 to 2 meters, and greater than 2 meters. These ranges correspond with knee-high or less, knee-high to head-high, and more than head-high depths.

For this risk assessment, the project team compared the improved parcels to the geographic extent of the tsunami. The results of the risk assessment, with estimated values in millions (M) and billions (B) of dollars, are shown in Table 8.

Table 8: Parcel Improvement Exposure Associated with a M7.2 Seattle Fault Earthquake-Induced Tsunami

COMMUNITY NAME	TOTAL ESTIMATED VALUE OF IMPROVED PARCELS	IMPROVED PARCELS VALUE IN TSUNAMI ZONE	TOTAL NUMBER OF IMPROVED PARCELS	TOTAL NUMBER OF IMPROVED PARCELS IN A TSUNAMI ZONE	PERCENTAGE OF IMPROVED PARCELS IN A TSUNAMI ZONE
Fife, City of	$1.3B	$530.0M	2,383	732	30.7%
Gig Harbor, City of	$1.5B	$19.2M	2,903	43	1.5%
Pierce County (Unincorporated Areas)	$26.6B	$81.4M	119,191	224	<1%
Tacoma, City of	$18.4B	$577.9M	64,379	499	<1%
University Place, City of	$2.7B	$14.3M	9,336	50	<1%
TOTAL	**$50.6B**	**$1.2B**	**198,192**	**1,548**	**<1%**

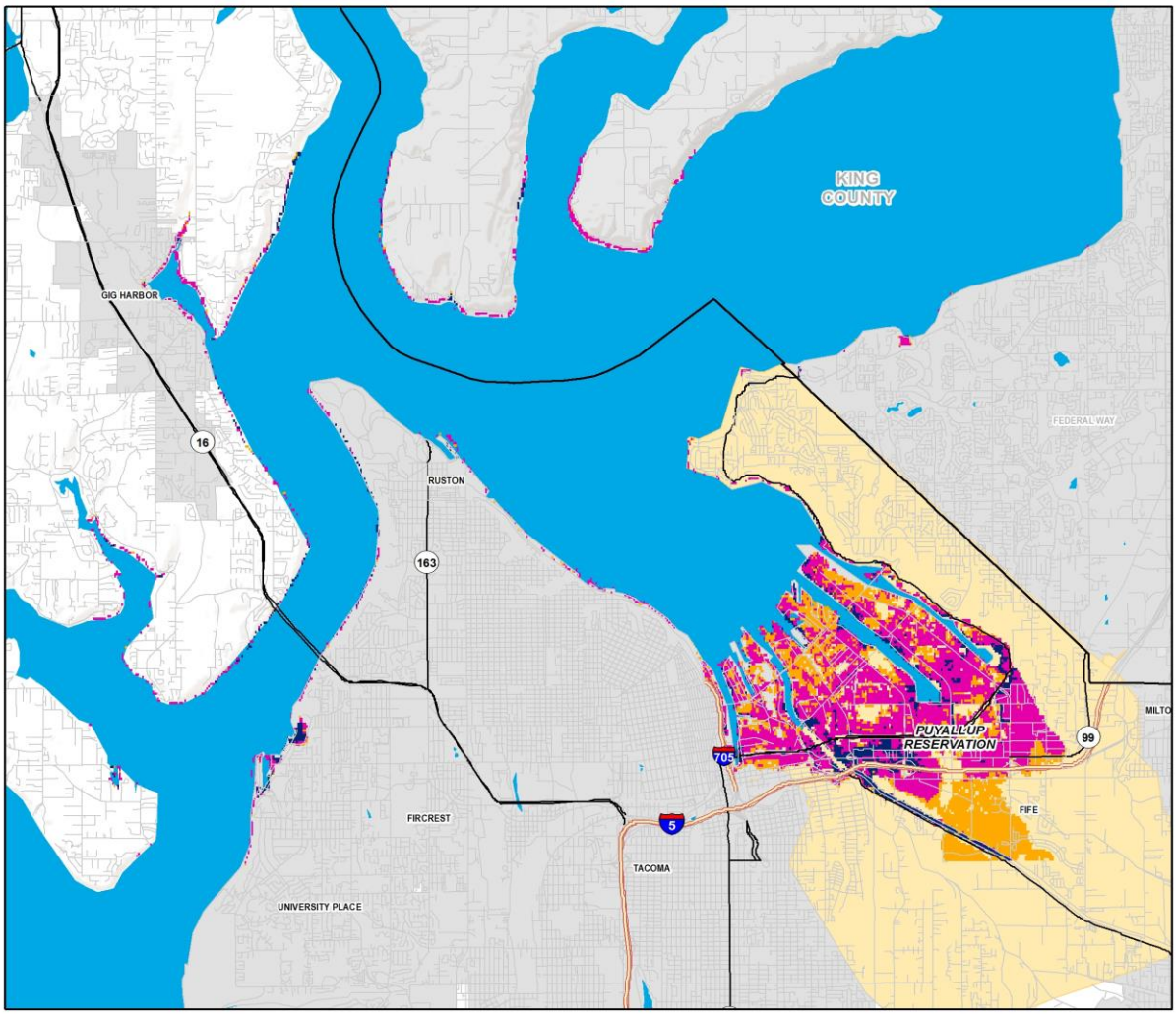
Note: The table above only includes communities identified as being within the tsunami inundation zone.

The project team determined that over $1.2 billion from 1,548 improved parcels in five communities would be at risk from a tsunami generated by an M7.2 Seattle fault earthquake. The Cities of Tacoma and Fife have the largest improved parcel value ($577 million and $530 million, respectively) within the tsunami zone. The community with the largest percentage of improved parcels that lie within a tsunami zone is the City of Fife with 30.7 percent of improved parcels impacted. Map 10 shows the depths of a tsunami generated by an M7.2 Seattle fault earthquake event.

State and local officials can use the tsunami inventory assessment to identify properties for mitigation projects as well as areas where additional outreach may be needed. Community-specific areas of greatest impact and potential mitigation actions are discussed in Section 9. All results, databases, and maps are provided in the Risk Assessment Database included with this Risk Report.

Map 10: Inundation for a Tsunami Generated by a M7.2 Seattle Fault Earthquake

TSUNAMI



MAP SYMBOLOGY

TSUNAMI DEPTH LESS THAN 0.5 METERS	(KNEE HIGH)
TSUNAMI DEPTH 0.5 TO 2 METERS	(HEAD HIGH)
TSUNAMI DEPTH OVER 2 METERS	(OVER HEAD)

ABOUT

This map displays areas of tsunami inundation caused by a Magnitude 7.2 Seattle Fault Earthquake.

Source data for this Risk Report was compiled from FEMA's Region X Office, FEMA's Map Service Center, USGS, and the State of Washington Department of Natural Resources. This is a non-regulatory product and is provided to your community for information gathering and sharing purposes only.

SCALE: 1 inch = 2 miles 1:126,720

SERVICE LAYER CREDITS: SOURCES: ESRI, USGS, NOAA

8. Volcanic Risk Assessment

Volcanic Hazard Overview

Mount Rainier is one of many active volcanoes along the Cascade Range. Volcanoes in the area are generated through a process known as subduction, where one tectonic plate slides beneath another. Off the Washington State coastline, the Juan de Fuca Plate slides underneath the North American Plate, generating earthquakes and volcanic activity. This process is not unique to the Pacific Northwest. It occurs throughout the Pacific where the plates beneath the ocean subside or pull past continental plates.

According to the USGS, Mount Rainier has been active for the past 500,000 years. The most recent lava flows occurred 2,200 years ago, and pyroclastic flows occurred as recently as 1,100 years ago. Geologically speaking, these events are relatively close to present day. Other unconfirmed events during the 19th century included reported sightings of steam, ash, and feeling minor eruptions.

Besides lava flow, an eruption of Mount Rainier could generate additional hazards including ash and tephra fall, pyroclastic flows, lahars (volcanic mudflows), earthquakes, landslides, and rock falls, as well as poisonous gas.

Volcanic Risk Assessment

The project team completed the Mount Rainier risk assessment using digital data generated by Shelling and others (2008), and from a volcano hazard assessment provided by Hoblitt and others (1998). The team generated volcanic hazard data for three lahar scenarios and included an additional pyroclastic hazard area.

For the purpose of this risk assessment, the project team merged the lahar scenarios and pyroclastic hazard area into one hazard category, which the team used to determine which improved parcels intersected a volcanic hazard area. The results of the risk assessment are shown in Table 9.

Table 9: Parcel Improvement Exposure Associated with a Volcanic Eruption of Mount Rainier

COMMUNITY NAME	TOTAL ESTIMATED VALUE OF IMPROVED PARCELS	IMPROVED PARCELS VALUE IN VOLCANIC ZONE	TOTAL NUMBER OF IMPROVED PARCELS	TOTAL NUMBER OF IMPROVED PARCELS IN A VOLCANIC ZONE	PERCENTAGE OF IMPROVED PARCELS IN A VOLCANIC ZONE
Auburn, City of*	$746.3M	$8.8M	2,545	50	2.0%
Bonney Lake, City of	$1.6B	$12.8M	6,372	41	<1%
Buckley, City of	$345.5M	$250.3K	1,488	1	<1%
Carbonado, Town of	$28.9M	$28.9M	228	228	100.0%
Eatonville, Town of	$181.0M	$3.4M	920	23	2.5%
Edgewood, City of	$830.3M	$15.9M	3,497	83	2.4%
Fife, City of	$1.3B	$1.3B	2,383	2,383	100.0%
Milton, City of*	$490.7M	$72.1M	1,874	300	16.0%

COMMUNITY NAME	TOTAL ESTIMATED VALUE OF IMPROVED PARCELS	IMPROVED PARCELS VALUE IN VOLCANIC ZONE	TOTAL NUMBER OF IMPROVED PARCELS	TOTAL NUMBER OF IMPROVED PARCELS IN A VOLCANIC ZONE	PERCENTAGE OF IMPROVED PARCELS IN A VOLCANIC ZONE
Orting, City of	$444.7M	$444.7M	2,283	2,283	100.0%
Pacific, City of*	$71.8M	$71.7M	158	156	98.7%
Pierce County (Unincorporated Areas)	$26.6B	$1.0B	119,191	5,330	4.5%
Puyallup, City of	$4.4B	$2.0B	11,233	5,710	50.8%
South Prairie, Town of	$20.4M	$20.1M	142	137	96.5%
Sumner, City of	$1.3B	$1.3B	3,054	3,043	99.6%
Tacoma, City of	$18.4B	$684.1M	64,379	440	<1%
Wilkeson, Town of	$26.5M	$26.5M	196	195	99.5%
TOTAL	**$57.0B**	**$7.1B**	**219,943**	**20,403**	**9.3%**

Note: The table above only includes communities which were identified as being within the lahar or pyroclastic area.

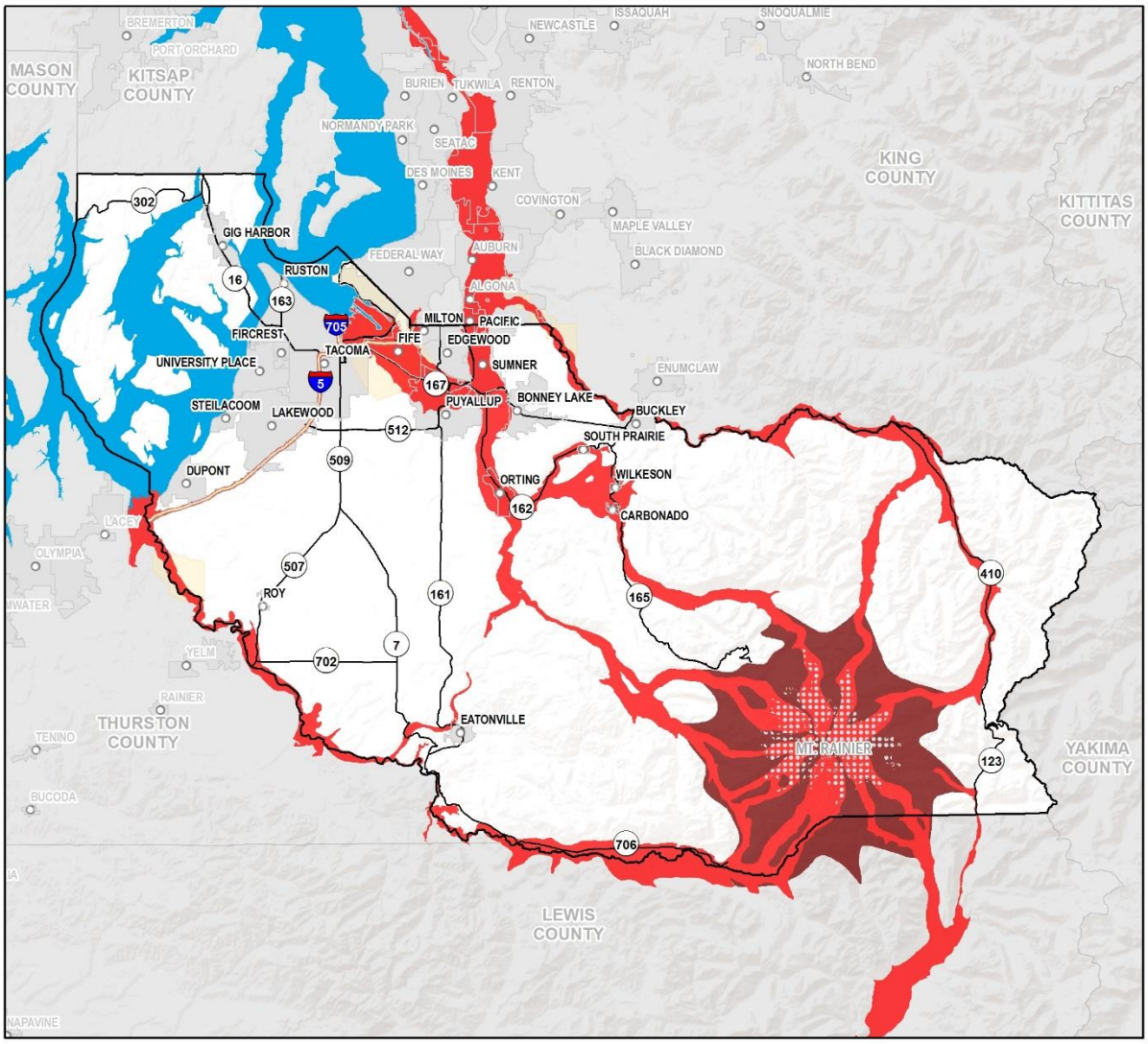
*Multi-county community (only includes information for the portion of the community located in Pierce County).

Seven communities have over 95 percent of User Defined Facilities (UDFs) identified within a Mount Rainier volcanic hazard area. Of those seven, three are at 100 percent (Town of Carbonado and Cities of Fife, and Orting). In regard to total improved parcel value, the Cities of Fife and Sumner have totals of over $1 billion among the seven communities. The largest total value in identified volcanic hazard areas across the county is found the City of Puyallup with just over $2 billion and 50.8 percent of improved parcels. Other communities with a high identified risk include the unincorporated areas of Pierce County ($1 billion and 5,330 improved parcels) and the City of Tacoma ($684 million and 440 improved parcels). In total, 9 percent of the improved parcels in the county, valued at almost $7.1 billion, are in a Mount Rainier volcanic hazard area.

State and local officials can use the volcanic inventory assessment to identify properties for mitigation projects as well as areas for additional outreach. Community-specific areas of greatest impact and potential mitigation actions are discussed in Section 9. All results, databases, and maps are provided in the Risk Assessment Database included with this Risk Report.

Map 11: Volcanic Hazard Areas Generated from a Mount Rainier Eruption

VOLCANIC HAZARDS



MAP SYMBOLOGY

- LAHAR FLOW HAZARD AREA
- PYROCLASTIC FLOW HAZARD AREA
- RISK REPORT AREA

ABOUT

This map displays risk from lahar and pyroclastic flows generated from a volcanic eruption of Mt. Rainier.

Source data for this Risk Report was compiled from FEMA's Region X Office, FEMA's Map Service Center, USGS, and the State of Washington Department of Natural Resources. This is a non-regulatory product and is provided to your community for information gathering and sharing purposes only.

SCALE: 1 inch = 10 miles 1:633,600

SERVICE LAYER CREDITS: SOURCES: ESRI, USGS, NOAA

9. Areas of Mitigation Interest and Recommended Resilience Strategies

This section of the Risk Report takes risk findings from Hazus models and other hazard overlays and focuses on specific areas where mitigation efforts should occur. These areas are called Areas of Mitigation Interest (AOMIs). The project team developed the AOMIs through conversations with each community during the Risk MAP process, as well as through analysis of various datasets for flood, earthquake, tsunami, landslide, and volcano hazards. The AOMI targets areas where potential damage, economic loss, and casualties could occur from a hazard event. FEMA has developed proposed strategies for mitigation in these specific areas. These resilience strategies advise ways the risks to hazards can be reduced, thereby reducing potential damages, economic loss, and casualties during hazard events. The resilience strategies suggest potential projects for hazard mitigation, encourage local collaboration, and communicate how various mitigation activities can successfully reduce risk.

This section of this report is broken down by individual community to create a more specific discussion of mitigation for each jurisdiction.

Pierce County, Unincorporated Areas of: Areas of Mitigation Interest and Recommended Resilience Strategies

Based on the Hazus risk assessment, the project team completed an overall hazard assessment for the county, which includes the buildings most impacted by one or more hazards. Table 10 highlights some of the buildings that are affected by earthquake, flood, and landslide in the unincorporated areas of Pierce County.

Table 10: Areas of Mitigation Interest for Unincorporated Areas of Pierce County

COMMUNITY FACILITY	ADDRESS	BUILDING VALUE	LOSS VALUE	LOSS RATIO	HAZARD TYPE
PCSD - PENINSULA	6006 133RD ST NW	$541.4K	$384.8K (EQ)	71.1% (EQ)	EARTHQUAKE, LANDSLIDE
OLD TOWN DOCK	2123 SCHUSTER PKWY	$986.6K	$78.8K	64.0%	FLOOD
PIERCE COUNTY FIRE DISTRICT 16 - STATION 45 (VOLUNTEER)	12310 WRIGHT-BILSS RD KN	$1.4M	$851.2K	61.2%	EARTHQUAKE
PIERCE COUNTY UTILITIES	6115 133RD ST NW	$4.4M	$2.5M	56.6%	EARTHQUAKE
GIG HARBOR FIRE & MEDIC ONE - STATION 57 (VOLUNTEER)	10521 CRESCENT VALLEY DR NW	$316.7K	$112.0K	35.4%	EARTHQUAKE
KEY CENTER LIBRARY	8905 KEY PENINSULA HWY N	$1.0M	$324.4K	32.4%	EARTHQUAKE
GIG HARBOR FIRE & MEDIC ONE - STATION 58	10302 BUJACICH RD NW	$770.4K	$246.8K	32.0%	EARTHQUAKE

COMMUNITY FACILITY	ADDRESS	BUILDING VALUE	LOSS VALUE	LOSS RATIO	HAZARD TYPE
WASHINGTON CORRECTIONS CENTER FOR WOMEN	9601 BUJACICH RD NW	$36.9M	$11.8M	32.0%	EARTHQUAKE
PENINSULA HIGH SCHOOL / PURDY ELEMENTARY SCHOOL*	14105 PURDY DR NW / 13815 62ND AV NW	$26.0M	$6.2M (EQ)	24.0% (EQ)	EARTHQUAKE, LANDSLIDE

*Facilities share the same UDF Parcel

Hazard Mitigation Plan Analysis

The Pierce County Hazard Mitigation Plan, effective through July 23, 2020, identifies the hazard mitigation projects, shown in Table 11, that can be aided by the information in this Risk Report.

Table 11: Hazard Mitigation Plan Analysis for Unincorporated Areas of Pierce County

HAZARD	PROJECTS	ADDITIONAL INFORMATION FROM RISK REPORT
Multi-hazard	Develop and provide all-hazards public education campaigns.	Utilize Risk Report and Risk Database to inform education material and expand and improve upon existing outreach.
Flood	The county will continue to maintain and design new county-owned flood control infrastructure to reduce the chance of failure during flood events.	Utilize Risk Report and Risk Database to prioritize structures at highest flood risk to inform flood control infrastructure maintenance and development.
Earthquake	Continue Bridge Retrofit Program for 160 bridges for seismic retrofit and eventual replacement.	Utilize Risk Report and Risk Database to prioritize the bridges most in need of seismic retrofit or replacement.
Volcano/Lahar	Continue public education programs for areas of the county threatened by lahars.	Utilize Risk Report and Risk Database to identify at-risk valleys and develop/refine outreach materials.

Recommended Resilience Strategies

Based on the assessment above, FEMA recommends the resilience strategies in Table 12.

Table 12: Recommended Resilience Strategies for Unincorporated Areas of Pierce County

PROBLEM STATEMENT	RECOMMENDED STRATEGIES
Pierce County's essential facilities are at risk during a Tacoma Fault 7.1M earthquake, leaving 16.7 percent of police facilities, 20.4 percent of fire facilities, and 26.3 percent of schools non-functional following the event.	• Develop a priority list for essential facility earthquake retrofits. • Conduct a hazard assessment or clarification for sewer treatment facilities throughout the county. • Construct seismic retrofits for Peninsula Schools. • Develop contingencies in the case of essential facility failure.
Forty-four percent of structures in the unincorporated areas of Pierce County were built before modern building codes, and 5.9 percent of structures are in the moderate or higher liquefaction zone. This could result in significant damage during an earthquake.	• Develop a priority list for essential facility earthquake retrofits. • Develop an outreach strategy or mitigation program for homeowners or businesses to retrofit older buildings.
Pierce County has 119,191 structures within the landslide zone which represent $464M in value.	• Provide outreach to homeowners regarding the landslide risk. • Consider limiting additional development in landslide hazard zones. • Move or harden essential facilities and infrastructure in landslide hazard zones. • Develop a buyout program for homes in landslide areas.
Residents are at risk to flooding from the Puyallup River Levee.	• Explore a levee setback, levee certification, additional grant buyout programs, and/or other structural and non-structural solutions to protect residents behind the levee.

While Federal funding for the above projects is limited, FEMA recommends that Pierce County incorporate these projects into the Natural Hazards Mitigation Plan should disaster funds become available. Additional funding may be available through the county Capital Improvement Planning process; bond authority; or other local, State, or private funding source. More information on how to mitigate for natural hazards can be found in the FEMA Local Mitigation Planning Handbook, which is accessible through http://www.fema.gov/media-library/assets/documents/31598?id=7209.

Additional information on integrating a Hazard Mitigation Plan with the local planning process is accessible through http://www.fema.gov/media-library/assets/documents/19261?id=4267.

City of Auburn: Areas of Mitigation Interest and Recommended Resilience Strategies

Based on the Hazus risk assessment, the project team completed an overall hazard assessment for the county that includes the buildings most impacted by multiple hazards. No essential facilities within the City of Auburn were available for the Hazus risk assessment, because most of the city is in King County.

Table 13: Areas of Mitigation Interest for City of Auburn

COMMUNITY FACILITY	ADDRESS	BUILDING VALUE	LOSS VALUE	LOSS RATIO	HAZARD TYPE
GOVERNMENT (EMERGENCY SERVICES)	1404 TO 1416 LAKE TAPPS PKWY E	$22.6M	$2.9M	12.7%	EARTHQUAKE

Hazard Mitigation Plan Analysis

The King County Hazard Mitigation Plan, effective through May 1, 2020, includes the City of Auburn and identifies the hazard mitigation projects, shown in Table 14, that can be aided by the information in this Risk Report.

Table 14: City of Auburn Hazard Mitigation Plan Analysis

HAZARD	PROJECTS	ADDITIONAL INFORMATION FROM RISK REPORT
Multi-hazard	Prepare and adopt a new Comprehensive Plan element for natural hazard reduction.	Utilize Risk Report and Risk Database to inform the natural hazard element of the Comprehensive Plan.
Landslide	Develop and adopt changes to the City Code to limit tree removal within certain sloped or landslide hazard susceptible areas.	Utilize Risk Report and Risk Database to identify locations of landslide risk for tree removal limitation.

Recommended Resilience Strategies

Based on the assessment above, FEMA recommends the strategies shown in Table 15.

Table 15: Recommended Resilience Strategies for City of Auburn

PROBLEM STATEMENT	RECOMMENDED STRATEGIES
Auburn has 2,545 structures at risk during an M7.1 Tacoma Fault Earthquake, representing a loss of $35M.	• Develop a priority list for essential facility earthquake retrofits. • Develop and distribute information to homeowners regarding retrofitting of residential structures.
Auburn's risk for flooding, landslide, and wildfire may be impacted due to changing environmental conditions.	• Develop an Environmental Hazard Resiliency Plan to outline the city's risk and plan for addressing resilience.

While Federal funding for the above projects is limited, FEMA recommends incorporating these projects into the county's Hazard Mitigation Plan should disaster funds become available. Additional funding may be available through the city's Capital Improvement Planning process; bond authority; or other local,

State, or private funding source. More information on how to mitigate for natural hazards can be found in the FEMA Local Mitigation Planning Handbook, which is accessible through http://www.fema.gov/media-library/assets/documents/31598?id=7209.

Additional information on integrating a Hazard Mitigation Plan with the local planning process is accessible through http://www.fema.gov/media-library/assets/documents/19261?id=4267.

City of Bonney Lake: Areas of Mitigation Interest and Recommended Resilience Strategies

Based on the Hazus risk assessment, the project team completed an overall hazard assessment for the county that includes the buildings most impacted by one or more hazards. Table 16 highlights some of the buildings that are affected by earthquake hazards in the City of Bonney Lake.

Table 16: Areas of Mitigation Interest for City of Bonney Lake

COMMUNITY FACILITY	ADDRESS	BUILDING VALUE	LOSS VALUE	LOSS RATIO	HAZARD TYPE
GOVERNMENT (GENERAL)	1110 182ND AV E	$60.3K	$7.7K	12.8%	EARTHQUAKE
EMERALD HILLS ELEMENTARY SCHOOL	19515 SOUTH TAPPS DR E	$10.0M	$655.8K	6.6%	EARTHQUAKE
BONNEY LAKE ELEMENTARY SCHOOL	18715 80TH ST E	$9.6M	$631.1K	6.6%	EARTHQUAKE
GOVERNMENT (EMERGENCY SERVICES)	9301 192ND AV E	$10.7M	$635.6K	6.0%	EARTHQUAKE
GOVERNMENT (EMERGENCY SERVICES)	19420 SR 410 E	$2.6M	$134.3K	5.1%	EARTHQUAKE
GOVERNMENT (EMERGENCY SERVICES)	19520 SR 410 E	$2.0M	$99.2K	5.1%	EARTHQUAKE
GOVERNMENT (EMERGENCY SERVICES)	19910 SOUTH PRAIRIE RD	$1.3M	$62.9K	5.1%	EARTHQUAKE
GOVERNMENT (EMERGENCY SERVICES)	19940 SOUTH PRAIRIE RD	$1.1M	$53.8K	5.1%	EARTHQUAKE
GOVERNMENT (EMERGENCY SERVICES)	19420 SR 410 E	$787.2K	$40.0K	5.1%	EARTHQUAKE
BONNEY LAKE HIGH SCHOOL	10920 199TH AVCT E	$38.6M	$1.7M	4.4%	EARTHQUAKE

COMMUNITY FACILITY	ADDRESS	BUILDING VALUE	LOSS VALUE	LOSS RATIO	HAZARD TYPE
MOUNTAIN VIEW MIDDLE SCHOOL	10921 199TH AVCT E	$13.9M	$612.5K	4.4%	EARTHQUAKE
EAST PIERCE FIRE & RESCUE - STATION 113	4824 AQUA DR E	$22.0K	$529	2.4%	EARTHQUAKE

Hazard Mitigation Plan Analysis

The Pierce County Hazard Mitigation Plan, effective July 23, 2020, includes the City of Bonney Lake and identifies the hazard mitigation projects, shown in Table 17, that can be aided by the information in this Risk Report.

Table 17: Hazard Mitigation Plan Analysis for City of Bonney Lake

HAZARD	PROJECTS	ADDITIONAL INFORMATION FROM RISK REPORT
Multi-hazard and Earthquake	Identify critical facilities and evaluate vulnerabilities to earthquakes and other hazards.	Utilize Risk Report and Risk Database to identify critical facilities most at risk as the foundation for mitigation strategy development and to prioritize retrofits.
Multi-hazard	Develop a comprehensive Disaster Recovery Plan.	Utilize Risk Report and Risk Database to inform the recovery plan, including transportation and critical facility impacts.
Earthquake	Continue Bridge Retrofit Program for seismic retrofit and eventual replacement of bridges.	Utilize Risk Report and Risk Database to prioritize the bridges most in need of seismic retrofit or replacement.
Flood	Continue public education programs for residents to reduce flood damages.	Utilize Risk Report and Risk Database to identify at-risk structures to prioritize outreach.

Recommended Resilience Strategies

Based on the assessment above, FEMA recommends the strategies in Table 18.

Table 18: Recommended Resilience Strategies for City of Bonney Lake

PROBLEM STATEMENT	RECOMMENDED STRATEGIES
Bonney Lake has 41 structures with an estimated value of $12.8 million located in the volcanic hazard area.	• Provide outreach to homeowners regarding the volcano risk. • Consider limiting additional development in volcano hazard zones. • Move essential facilities and infrastructure out of volcano hazard zones. • Check volcano evacuation routes for post-event functionality.
Bonney Lake has 512 (8.1 percent) structures built before modern building codes and 102 structures located in a moderate or higher liquefaction zone. This could result in significant damage during an earthquake.	• Develop a priority list for essential facility earthquake retrofits. • Develop an outreach strategy or mitigation program for homeowners or businesses to retrofit older buildings.

While Federal funding for the above projects is limited, FEMA recommends incorporating these projects into the county's Natural Hazards Mitigation Plan should disaster funds become available. Additional funding may be available through the city's Capital Improvement Planning process; bond authority; or other local, State, or private funding source. More information on how to mitigate for natural hazards can be found in the FEMA Local Mitigation Planning Handbook, which is accessible through http://www.fema.gov/media-library/assets/documents/31598?id=7209.

Additional information on integrating a Hazard Mitigation Plan with the local planning process is accessible through http://www.fema.gov/media-library/assets/documents/19261?id=4267.

City of Buckley: Areas of Mitigation Interest and Recommended Resilience Strategies

Based on the Hazus risk assessment, the project team completed an overall hazard assessment for the county that includes the buildings most impacted by one or more hazards. Table 19 highlights some of the buildings that are impacted by earthquake and liquefaction in the City of Buckley.

Table 19: Areas of Mitigation Interest for City of Buckley

COMMUNITY FACILITY	ADDRESS	BUILDING VALUE	LOSS VALUE	LOSS RATIO	HAZARD TYPE
BUCKLEY POLICE DEPARTMENT	133 SOUTH CEDAR STREET	$523.0K	$21.0K	4.0%	EARTHQUAKE, LIQUEFACTION
CITY OF BUCKLEY FIRE DEPARTMENT	611 S DIVISION ST	$1.4M	$21.0K	1.5%	EARTHQUAKE, LIQUEFACTION
ELK RIDGE ELEMENTARY SCHOOL / GLACIER MIDDLE SCHOOL*	340 N RIVER AV / 240 N C ST	$10.2M	$150.2K	1.5%	EARTHQUAKE, LIQUEFACTION

COMMUNITY FACILITY	ADDRESS	BUILDING VALUE	LOSS VALUE	LOSS RATIO	HAZARD TYPE
GOVERNMENT (GENERAL)	XXX N MCNEELY ST	$3.5K	**	**	FLOODING, LIQUEFACTION

*Facilities share the same UDF Parcel
**Flood loss data not available

Hazard Mitigation Plan Analysis

The Pierce County Hazard Mitigation Plan, effective through July 23, 2020, includes the City of Buckley and identifies the hazard mitigation projects, shown in Table 20, that can be aided by the information in this Risk Report.

Table 20: Hazard Mitigation Plan Analysis for City of Buckley

HAZARD	PROJECTS	ADDITIONAL INFORMATION FROM RISK REPORT
Multi-hazard	Take advantage of three major community events to distribute educational materials regarding emergency preparedness.	Utilize Risk Report and Risk Database to inform educational material and expand the conversation to include mitigation to improve overall awareness and preparedness.
Earthquake	Identify and evaluate critical facilities for earthquake structural integrity.	Utilize Risk Report and Risk Database to identify critical facilities most at risk for seismic failure to prioritize retrofits.

Recommended Resilience Strategies

Based on the assessment above, FEMA recommends the strategies shown in Table 21.

Table 21: Recommended Resilience Strategies for City of Buckley

PROBLEM STATEMENT	RECOMMENDED STRATEGIES
Buckley has 44.8 percent of its structures built before modern building codes and 98.5 percent are located within the moderate or higher liquefaction zone. This could result in significant damage during an earthquake.	• Develop a priority list for essential facility earthquake retrofits, including waterline main. • Continue the retrofit/remodel of schools, including the retrofit of the middle school gym for use as a shelter. • Develop an outreach strategy or mitigation program for homeowners or businesses to retrofit older buildings • Utilize Risk MAP assessment to provide residents with more robust hazard risk information. Compliment ongoing outreach through utility bills. • Acquire water system generator.
A pedestrian bridge being constructed across the White River is at risk to multiple hazards.	• Coordinate with King County to discuss use of the bridge as an evacuation route if the main bridge collapses.
Buckley is at risk to severe winter storms.	• Prioritize locations for undergrounding utility lines.

While Federal funding for the above projects is limited, FEMA recommends incorporating these projects into the county's Natural Hazards Mitigation Plan should disaster funds become available. Additional

funding may be available through the city's Capital Improvement Planning process; bond authority; or other local, State, or private funding source. More information on how to mitigate for natural hazards can be found in the FEMA Local Mitigation Planning Handbook, which is accessible through http://www.fema.gov/media-library/assets/documents/31598?id=7209.

Additional information on integrating a Hazard Mitigation Plan with the local planning process is accessible through http://www.fema.gov/media-library/assets/documents/19261?id=4267.

Town of Carbonado: Areas of Mitigation Interest and Recommended Resilience Strategies

Based on the Hazus risk assessment, the project team completed an overall hazard assessment for the county that includes the buildings most impacted by one or more hazards. Table 22 highlights some of the buildings that are affected by earthquake, liquefaction, lahar, and volcano hazards in the Town of Carbonado.

Table 22: Areas of Mitigation Interest for Town of Carbonado

COMMUNITY FACILITY	ADDRESS	BUILDING VALUE	LOSS VALUE	LOSS RATIO	HAZARD TYPE
CARBONADO ELEMENTARY SCHOOL	427 4TH ST	$1.9M	**	**	VOLCANO / LAHAR
CARBONADO FIRE DEPARTMENT (VOLUNTEER)	819 8TH AVE	$23.0K	**	**	VOLCANO / LAHAR
CARBONADO POST OFFICE	826 8TH AVE	$501.0K	**	**	LIQUEFACTION, LAHAR

Hazard Mitigation Plan Analysis

The Pierce County Hazard Mitigation Plan, effective through July 23, 2020, includes the Town of Carbonado and identifies hazard mitigation projects, shown in Table 23, that can be aided by the information in this Risk Report.

Table 23: Mitigation Plan Analysis for Town of Carbonado

HAZARD	PROJECTS	ADDITIONAL INFORMATION FROM RISK REPORT
Multi-hazard	Provide public education on emergency preparedness via website, annual mailer, and an annual public safety meeting.	Utilize Risk Report and Risk Database to inform educational material and expand the conversation to include mitigation to improve overall awareness and preparedness.
Multi-hazard	Obtain an alternate route for evacuation.	Utilize Risk Database information to identify bridges and transportation routes that will allow for safe evacuation from a variety of hazards.

Recommended Resilience Strategies

Based on the assessment above, FEMA recommends the strategies in Table 24.

Table 24: Recommended Resilience Strategies for Town of Carbonado

PROBLEM STATEMENT	RECOMMENDED STRATEGIES
Carbonado has 55.7 percent of its structures built before modern building codes. This could result in significant damage during an earthquake.	• Develop a priority list for essential facility earthquake retrofits. • Develop an outreach strategy or mitigation program for homeowners or businesses to retrofit older buildings. • Facilitate communication with Wilkeson to develop evacuation procedures.
100 percent of Carbonado's structures, worth over $28.8 million, are located in the volcanic hazard area.	• Provide outreach to homeowners regarding the volcano risk. • Consider limiting additional development in volcano hazard zones. • Move essential facilities and infrastructure out of the volcano hazard zones. • Check volcano evacuation routes for post-event functionality.

While Federal funding for the above projects is limited, FEMA recommends incorporating these projects into the county's Natural Hazards Mitigation Plan should disaster funds become available. Additional funding may be available through the town's Capital Improvement Planning process; bond authority; or other local, State, or private funding source. More information on how to mitigate for natural hazards can be found in the FEMA Local Mitigation Planning Handbook, which is accessible through http://www.fema.gov/media-library/assets/documents/31598?id=7209.

Additional information on integrating a Hazard Mitigation Plan with the local planning process is accessible through http://www.fema.gov/media-library/assets/documents/19261?id=4267.

City of DuPont: Areas of Mitigation Interest and Recommended Resilience Strategies

Based on the Hazus risk assessment, the project team completed an overall hazard assessment for the county that includes the buildings most impacted by one or more hazards. Table 25 highlights some of the buildings that are affected by earthquake in the City of DuPont.

Table 25: Areas of Mitigation Interest for City of DuPont

COMMUNITY FACILITY	ADDRESS	BUILDING VALUE	LOSS VALUE	LOSS RATIO	HAZARD TYPE
PIONEER MIDDLE SCHOOL	1750 BOBS HOLLOW LANE	$26.8M	$545.8K	2.0%	EARTHQUAKE
CHLOE CLARK ELEMENTARY SCHOOL	1700 PALISADE BLVD	$6.0M	$121.3K	2.0%	EARTHQUAKE

Hazard Mitigation Plan Analysis

The Pierce County Hazard Mitigation Plan, effective through July 23, 2020, includes the City of DuPont and identifies the hazard mitigation projects, shown in Table 26, that can be aided by the information in this Risk Report.

Table 26: Hazard Mitigation Plan Analysis for City of DuPont

HAZARD	PROJECTS	ADDITIONAL INFORMATION FROM RISK REPORT
Multi-hazard	Develop a Continuity of Operations Plan (COOP).	Utilize Risk Report and Risk Database to identify sectors most at risk as well as transportation routes that affect the COOP.
Multi-hazard	Develop a comprehensive Disaster Recovery Plan.	Utilize Risk Report and Risk Database to inform the recovery plan, including transportation and critical facility impacts.
Earthquake	Seismically strengthen city and privately owned structures.	Utilize Risk Report and Risk Database to prioritize structures most in need of seismic retrofit or replacement.

Recommended Resilience Strategies

Based on the assessment above, FEMA recommends the strategies shown in Table 27.

Table 27: Recommended Resilience Strategies for City of DuPont

PROBLEM STATEMENT	RECOMMENDED STRATEGIES
DuPont has 4 percent of its structures built before modern building codes and $8 million in structure value at risk from a Tacoma Fault M7.1 event.	• Develop a priority list for essential facility earthquake retrofits. • Improve and maintain the road through Hoffman Hill for emergency evacuation and response. • Develop an outreach strategy or mitigation program for homeowners or businesses to retrofit older buildings.
Government Vehicle Parking Lot is at risk to flooding in marshland.	• Determine open space to relocate the parking lot.
Historic village at risk of flooding at certain levels.	• Construct a stormwater conveyance system, aware of the surrounding marsh, to relieve flooding pressure.
City is at risk to tsunami.	• Install a tsunami warning system.

While Federal funding for the above projects is limited, FEMA recommends incorporating these projects into the county's Natural Hazards Mitigation Plan should disaster funds become available. Additional funding may be available through the city's Capital Improvement Planning process; bond authority; or

other local, State, or private funding source. More information on how to mitigate for natural hazards can be found in the FEMA Local Mitigation Planning Handbook, which is accessible through http://www.fema.gov/media-library/assets/documents/31598?id=7209.

Additional information on integrating a Hazard Mitigation Plan with the local planning process is accessible through http://www.fema.gov/media-library/assets/documents/19261?id=4267.

Town of Eatonville: Areas of Mitigation Interest and Recommended Resilience Strategies

Based on the Hazus risk assessment, the project team completed an overall hazard assessment for the county that includes the buildings most impacted by one or more hazards. Table 28 highlights some of the buildings that are affected by earthquake, landslide, and liquefaction in the Town of Eatonville.

Table 28: Areas of Mitigation Interest for Town of Eatonville

COMMUNITY FACILITY	ADDRESS	BUILDING VALUE	LOSS VALUE	LOSS RATIO	HAZARD TYPE
EATONVILLE ELEMENTARY SCHOOL	209 LYNCH CREEK ROAD	$3.6M	$22.1K	0.6%	EARTHQUAKE, LIQUEFACTION
EATONVILLE FIRE DEPARTMENT - STATION 84 / EATONVILLE POLICE DEPARTMENT*	201 W CENTER ST	$262.2K	$768	0.3%	EARTHQUAKE
EATONVILLE HIGH SCHOOL	302 MARSHELL AVE N	$3.5M	$10.1K	0.3%	EARTHQUAKE
EATONVILLE MIDDLE SCHOOL	207 CARTER ST E	$6.4M	$12.1K	0.2%	EARTHQUAKE, LIQUEFACTION
RESIDENTIAL STRUCTURE	OHOP VALLEY EXTENSION RD E/N	$221.9M	$342	0.2% (EQ)	LANDSLIDE

*Facilities share the same UDF Parcel

Hazard Mitigation Plan Analysis

The Pierce County Hazard Mitigation Plan, effective through July 23, 2020, includes the Town of Eatonville and identifies the hazard mitigation projects, shown in Table 29, that can be aided by the information in this Risk Report.

Table 29: Hazard Mitigation Plan Analysis for Town of Eatonville

HAZARD	PROJECTS	ADDITIONAL INFORMATION FROM RISK REPORT
Multi-hazard	Provide comprehensive public education campaigns for all hazard preparedness.	Utilize Risk Report and Risk Database to inform educational material and expand and improve upon existing outreach.

HAZARD	PROJECTS	ADDITIONAL INFORMATION FROM RISK REPORT
Multi-hazard	Develop a Continuity of Operations Plan (COOP).	Utilize Risk Report and Risk Database to identify sectors most at risk as well as transportation routes that affect the COOP.
Earthquake	Evaluate seismic safety of town-owned critical facilities and prioritize retrofits and replacement for the most vulnerable structures.	Utilize Risk Report and Risk Database to inform prioritization of critical facilities most in need of seismic retrofit or replacement.

Recommended Resilience Strategies

Based on the assessment above, FEMA recommends the strategies shown in Table 30.

Table 30: Recommended Resilience Strategies for Town of Eatonville

PROBLEM STATEMENT	RECOMMENDED STRATEGIES
Eatonville has 17 buildings within the landslide zone representing $4M in value.	• Provide outreach to homeowners regarding the landslide risk. • Consider limiting additional development in landslide hazard zones. • Move or harden essential facilities and infrastructure out of landslide hazard zones. • Develop a buyout program for homes in landslide areas.
Eatonville has 14 percent of its structures located in the moderate or higher liquefaction zone and 30 percent of structures were built before modern building codes. This could result in significant damages during an earthquake.	• Develop a priority list for essential facility earthquake retrofits. • Develop an outreach strategy or mitigation program for homeowners or businesses to retrofit older buildings.

While Federal funding for the above projects is limited, FEMA recommends incorporating these projects into the county's Natural Hazards Mitigation Plan should disaster funds become available. Additional funding may be available through the town's Capital Improvement Planning process; bond authority; or other local, State, or private funding source. More information on how to mitigate for natural hazards can be found in the FEMA Local Mitigation Planning Handbook, which is accessible through http://www.fema.gov/media-library/assets/documents/31598?id=7209.

Additional information on integrating a Hazard Mitigation Plan with the local planning process is accessible through http://www.fema.gov/media-library/assets/documents/19261?id=4267.

City of Edgewood: Areas of Mitigation Interest and Recommended Resilience Strategies

Based on the Hazus risk assessment, the project team completed an overall hazard assessment for the county that includes the buildings most impacted by one or more hazards. Table 31 highlights some of the buildings that are affected by earthquake in the City of Edgewood.

Table 31: Areas of Mitigation Interest for City of Edgewood

COMMUNITY FACILITY	ADDRESS	BUILDING VALUE	LOSS VALUE	LOSS RATIO	HAZARD TYPE
NORTHWOOD ELEMENTARY SCHOOL	9805 24TH ST E	$2.2M	$239.0K	11.1%	EARTHQUAKE
MOUNTAIN VIEW ELEMENTARY SCHOOL	3411 119TH AVE E	$3.7M	$352.2K	9.5%	EARTHQUAKE
EDGEMONT JUNIOR HIGH SCHOOL	2300 110TH AVE E	$5.1M	$453.2K	8.9%	EARTHQUAKE
EAST PIERCE FIRE & RESCUE - STATION 118	10105 24TH ST E	$1.1M	$54.1K	5.0%	EARTHQUAKE
HEDDEN ELEMENTARY SCHOOL	11313 8TH ST E	$11.0M	$543.3K	5.0%	EARTHQUAKE
PCSD - EDGEWOOD	2221 MERIDIAN AVE E	$548.9K	$21.0K	3.8%	EARTHQUAKE

Hazard Mitigation Plan Analysis

The Pierce County Hazard Mitigation Plan, effective through July 23, 2020, includes the City of Edgewood and identifies the hazard mitigation projects, shown in Table 32, that can be aided by the information in this Risk Report.

Table 32: Hazard Mitigation Plan Analysis for City of Edgewood

HAZARD	PROJECTS	ADDITIONAL INFORMATION FROM RISK REPORT
Multi-hazard	Develop emergency planning transportation overlays.	Utilize Risk Report and Risk Database to identify and utilize routes that will remain functional after an event.
Flood	Conduct assessment and develop a strategy for city roads impacted by flooding.	Utilize Risk Report and Risk Database to identify roads in the SFHA and identify appropriate flood mitigation strategies.
Flood	Identify and mitigate flood-prone properties.	Utilize Risk Report and Risk Database to identify properties in the SFHA and identify appropriate flood mitigation strategies.
Earthquake	Identify and mitigate city-owned infrastructure in need of seismic retrofit or replacement.	Utilize Risk Report and Risk Database to identify and prioritize infrastructure most in need of seismic retrofit or replacement.

Recommended Resilience Strategies

Based on the assessment above, FEMA recommends the strategies shown in Table 33.

Table 33: Recommended Resilience Strategies for City of Edgewood

PROBLEM STATEMENT	RECOMMENDED STRATEGIES
Edgewood's essential facilities are at risk during a Tacoma Fault M7.1 earthquake, leaving 75 percent of its school facilities non-functional following the event.	• Develop a priority list for essential facility earthquake retrofits.
54.9 percent of Edgewood's structures were built before modern building codes and 5.6 percent are located in the moderate or higher liquefaction zone. This could result in significant damages during an earthquake.	• Develop a priority list for essential facility earthquake retrofits. • Develop an outreach strategy or mitigation program for homeowners or businesses to retrofit older buildings.

While Federal funding for the above projects is limited, FEMA recommends incorporating these projects into the county's Natural Hazards Mitigation Plan should disaster funds become available. Additional funding may be available through the city's Capital Improvement Planning process; bond authority; or other local, State, or private funding source. More information on how to mitigate for natural hazards can be found in the FEMA Local Mitigation Planning Handbook, which is accessible through http://www.fema.gov/media-library/assets/documents/31598?id=7209.

Additional information on integrating a Hazard Mitigation Plan with the local planning process is accessible through http://www.fema.gov/media-library/assets/documents/19261?id=4267.

City of Fife: Areas of Mitigation Interest and Recommended Resilience Strategies

Based on the Hazus risk assessment, the project team completed an overall hazard assessment for the county that includes the buildings most impacted by one or more hazards. Table 34 highlights some of the buildings that are affected by earthquake, liquefaction, lahar, tsunami, and volcano in the City of Fife.

Table 34: Areas of Mitigation Interest for City of Fife

COMMUNITY FACILITY	ADDRESS	BUILDING VALUE	LOSS VALUE	LOSS RATIO	HAZARD TYPE
CARDINAL HEALTH	6710 26TH ST E	$10.6M	$849.6K (EQ)	8.0%	EARTHQUAKE, LIQUEFACTION, VOLCANO / LAHAR
FIFE HIGH SCHOOL	5616 20TH ST E	$13.8M	$1.1M (EQ)	8.0%	EARTHQUAKE, LIQUEFACTION, VOLCANO / LAHAR
TACOMA FIRE DEPARTMENT - STATION 12	2015 54TH AVE EAST	$611.0K	$45.4K (EQ)	7.4%	EARTHQUAKE, LIQUEFACTION, VOLCANO / LAHAR

COMMUNITY FACILITY	ADDRESS	BUILDING VALUE	LOSS VALUE	LOSS RATIO	HAZARD TYPE
MULTICARE HEALTHWORKS - FIFE	502 54TH AVE E	$1.0M	$33.5K (EQ)	3.2%	EARTHQUAKE, LIQUEFACTION, VOLCANO / LAHAR, TSUNAMI
FIFE POLICE DEPARTMENT	3737 PACIFIC HIGHWAY E	$2.5M	$72.1K (EQ)	2.9%	EARTHQUAKE, LIQUEFACTION, VOLCANO / LAHAR
ALL SAINTS SCHOOL - FIFE	2323 54TH AVE E	$5.7M	$165.4K (EQ)	2.9%	EARTHQUAKE, LIQUEFACTION, VOLCANO / LAHAR, TSUNAMI
COLUMBIA JUNIOR HIGH SCHOOL	2901 54TH AVE E	$21.5M	$608.9K (EQ)	2.8%	EARTHQUAKE, LIQUEFACTION, VOLCANO / LAHAR, TSUNAMI

Hazard Mitigation Plan Analysis

The Pierce County Hazard Mitigation Plan, effective through July 23, 2020, includes the City of Fife and identifies the hazard mitigation projects, shown in Table 35, that can be aided by the information in this Risk Report.

Table 35: Hazard Mitigation Plan Analysis for City of Fife

HAZARD	PROJECTS	ADDITIONAL INFORMATION FROM RISK REPORT
Multi-hazard	Develop and provide all-hazards preparedness public education program.	Utilize Risk Report and Risk Database to inform educational material and expand and improve upon existing outreach.
Multi-hazard	Develop a Continuity of Operations Plan (COOP).	Utilize Risk Report and Risk Database to identify sectors most at risk, as well as transportation routes that affect the COOP.
Volcano/Lahar	Continue public education programs addressing the lahar hazard, warning system, preparedness, and evacuation routes.	Utilize Risk Report and Risk Database to identify at-risk valleys and develop/refine outreach materials.

Recommended Resilience Strategies

Based on the assessment above, FEMA recommends the strategies shown in Table 36.

Table 36: Recommended Resilience Strategies for City of Fife

PROBLEM STATEMENT	RECOMMENDED STRATEGIES
Fife's essential facilities are at risk during a Tacoma Fault M7.1 earthquake, leaving 50 percent of medical facilities, 100 percent of fire facilities, and 33 percent of schools non-functional following the event.	• Develop a priority list for essential facility earthquake retrofits. • Conduct retrofit or relocation of the Fife fire station. • Determine relocation and/or retrofit for police station and jail.
There are 732 buildings in Fife, valued at over $530M, located in the tsunami zone; only 105 of those properties have flood insurance with total coverage of about $34M.	• Develop an outreach strategy to help homeowners, realtors, and insurance agents understand the value of flood insurance for tsunami risk. • Coordinate with USACE to certify the North Levee Road Project. Develop relevant education and outreach to inform communities of levee flood risks.
100 percent of Fife's structures, worth over $1.3B, are located in the volcano hazard area.	• Provide outreach to homeowners regarding the volcano risk. • Consider limiting additional development in volcano hazard zones. • Move essential facilities and infrastructure in volcano hazard zones. • Check volcano evacuation routes for post-event functionality.

While Federal funding for the above projects is limited, FEMA recommends incorporating these projects into the county's Natural Hazards Mitigation Plan should disaster funds become available. Additional funding may be available through the city's Capital Improvement Planning process; bond authority; or other local, State, or private funding source. More information on how to mitigate for natural hazards can be found in the FEMA Local Mitigation Planning Handbook, which is accessible through http://www.fema.gov/media-library/assets/documents/31598?id=7209.

Additional information on integrating a Hazard Mitigation Plan with the local planning process is accessible through http://www.fema.gov/media-library/assets/documents/19261?id=4267.

City of Fircrest: Areas of Mitigation Interest and Recommended Resilience Strategies

Based on the Hazus risk assessment, the project team completed an overall hazard assessment for the county that includes the buildings most impacted by one or more hazards. Table 37 highlights some of the buildings that are affected by earthquake and liquefaction in the City of Fircrest.

Table 37: Areas of Mitigation Interest for City of Fircrest

COMMUNITY FACILITY	ADDRESS	BUILDING VALUE	LOSS VALUE	LOSS RATIO	HAZARD TYPE
TACOMA FIRE DEPARTMENT - STATION 17 / FIRCREST POLICE DEPARTMENT*	302 REGENTS BLVD	$771.5K	$49.2K	6.4%	EARTHQUAKE
WHITTIER ELEMENTARY SCHOOL	777 ELM TREE LN	$3.8M	$106.9K	2.8%	EARTHQUAKE
CITY HALL	115 RAMSDELL STREET	$1.6M	$41.0K	2.6%	EARTHQUAKE
PUBLIC WORKS / UTILITIES	120 RAMSDELL STREET	$922.4K	$21.4K	2.3%	EARTHQUAKE

*Facilities share the same UDF Parcel

Hazard Mitigation Plan Analysis

The Pierce County Hazard Mitigation Plan, effective through July 23, 2020, includes the City of Fircrest and identifies the hazard mitigation projects, shown in Table 38, that can be aided by the information in this Risk Report.

Table 38: Hazard Mitigation Plan Analysis for City of Fircrest

HAZARD	PROJECTS	ADDITIONAL INFORMATION FROM RISK REPORT
Multi-hazard	Develop and provide information to the public on all-hazards disaster preparedness and mitigation.	Utilize Risk Report and Risk Database to inform educational material and expand and improve upon existing outreach.
Earthquake	Evaluate city-owned facilities to determine earthquake structural integrity.	Utilize Risk Report and Risk Database to identify and prioritize the facilities most in need of seismic retrofit or replacement.

Recommended Resilience Strategies

Based on the assessment above, FEMA recommends the strategies shown in Table 39.

Table 39: Recommended Resilience Strategies for City of Fircrest

PROBLEM STATEMENT	RECOMMENDED STRATEGIES
Fircrest has 72.6 percent of its structures built before modern building codes and 7 percent are located in the moderate or higher liquefaction zone. This could result in significant damage during an earthquake.	• Develop a priority list for essential facility earthquake retrofits. • Develop an outreach strategy or mitigation program for homeowners or businesses to retrofit older buildings. • Conduct a seismic evaluation for Whittier Elementary School. Retrofit where necessary. • Conduct a seismic retrofit for two Fircrest water towers.
City infrastructure is at risk to severe weather events, including ice storms.	• Acquire generators to provide reliable power for at least the city's critical facilities. • Establish the recreation center as an emergency shelter.

While Federal funding for the above projects is limited, FEMA recommends incorporating these projects into the county's Natural Hazards Mitigation Plan should disaster funds become available. Additional funding may be available through the city's Capital Improvement Planning process; bond authority; or other local, State, or private funding source. More information on how to mitigate for natural hazards can be found in the FEMA Local Mitigation Planning Handbook, which is accessible through http://www.fema.gov/media-library/assets/documents/31598?id=7209.

Additional information on integrating a Hazard Mitigation Plan with the local planning process is accessible through http://www.fema.gov/media-library/assets/documents/19261?id=4267.

City of Gig Harbor: Areas of Mitigation Interest and Recommended Resilience Strategies

Based on the Hazus risk assessment, the project team completed an overall hazard assessment for the county that includes the buildings most impacted by one or more hazards. Table 40 highlights some of the buildings that are affected by earthquake, flood, liquefaction, and tsunami in the City of Gig Harbor.

Table 40: Areas of Mitigation Interest for City of Gig Harbor

COMMUNITY FACILITY	ADDRESS	BUILDING VALUE	LOSS VALUE	LOSS RATIO	HAZARD TYPE
ST NICHOLAS CATHOLIC SCHOOL	3555 EDWARDS DR	$2.7M	$736.8K	27.5%	EARTHQUAKE
ST ANTHONY HOSPITAL	11567 CANTERWOOD BLVD NW	$106.2M	$28.8M	27.1%	EARTHQUAKE
GIG HARBOR COMMUNITY CENTER	3104 TO 3114 JUDSEN ST	$3.6M	$967.7K	26.8%	EARTHQUAKE

COMMUNITY FACILITY	ADDRESS	BUILDING VALUE	LOSS VALUE	LOSS RATIO	HAZARD TYPE
DISCOVERY ELEMENTARY SCHOOL - GIG HARBOR / GIG HARBOR HIGH SCHOOL / HENDERSON BAY HIGH SCHOOL	4905 ROSEDALE ST / 5101 ROSEDALE ST NW / 8402 SKANSIE AVE	$33.1M	$8.7M	26.2%	EARTHQUAKE
TACOMA COMMUNITY COLLEGE - GIG HARBOR CAMPUS	3993 HUNT ST NW	$1.8M	$381.3K	20.9%	EARTHQUAKE
HARBOR HISTORY MUSEUM	4121 HARBORVIEW DR	$2.6M	$213.9K (EQ)	8.2% (EQ)	FLOOD, TSUNAMI, EARTHQUAKE, LIQUEFACTION

Hazard Mitigation Plan Analysis

The Pierce County Hazard Mitigation Plan, effective through July 23, 2020, includes the City of Gig Harbor and identifies the hazard mitigation projects, shown in Table 42, that can be aided by the information in this Risk Report.

Table 41: Hazard Mitigation Plan Analysis for City of Gig Harbor

HAZARD	PROJECTS	ADDITIONAL INFORMATION FROM RISK REPORT
Multi-hazard	Develop a comprehensive disaster recovery plan to include long-term economic sustainability.	Utilize Risk Report and Risk Database to inform the recovery plan and identify structures and transportation routes at risk.
Multi-hazard	Develop evacuation plans for the neighborhoods in the city.	Utilize Risk Report and Risk Database to identify safe and reliable routes for evacuation.
Earthquake	Develop a seismic evaluation program for city facilities and shelters.	Utilize Risk Report and Risk Database to identify the facilities most in need of seismic retrofit or replacement.
Landslide	Discourage construction in landslide areas.	Utilize Risk Report and Risk Database to identify areas where construction should be avoided due to landslide risk.

Recommended Resilience Strategies

Based on the assessment above, FEMA recommends the strategies shown in Table 42.

Table 42: Recommended Resilience Strategies for City of Gig Harbor

PROBLEM STATEMENT	RECOMMENDED STRATEGIES
Gig Harbor has 2,903 structures at risk during an M7.1 Tacoma Fault Earthquake, representing a loss of $185M.	• Develop a priority list for essential facility earthquake retrofits. • Develop and distribute information to homeowners regarding retrofitting of residential structures.
Gig Harbor's essential facilities are at risk during a Tacoma Fault M7.1 earthquake, leaving 50 percent of medical facilities, 100 percent of fire facilities, and 80 percent of schools non-functional following the event.	• Develop a priority list for essential facility earthquake retrofit. • Assess the vulnerability of water tower and other water infrastructure. Retrofit where necessary. • Utilize Hazus data to prioritize seismic retrofits for schools.
Gig Harbor has seven buildings within the landslide zone, representing $7M in value.	• Provide outreach to homeowners regarding the landslide risk. • Consider limiting additional development in landslide hazard zones. • Move or harden essential facilities and infrastructure in landslide hazard zones. • Develop a buyout program for homes in landslide areas. • Use an upcoming landslide study to assess the vulnerability of the sewage treatment center.
There are 43 buildings in Gig Harbor, valued at over $19M, located in the tsunami zone; only 17 of those properties have flood insurance with total coverage of about $5.1M.	• Develop an outreach strategy to help homeowners, realtors, and insurance agents understand the value of flood insurance for tsunami risk.

While Federal funding for the above projects is limited, FEMA recommends incorporating these projects into the county's Natural Hazards Mitigation Plan should disaster funds become available. Additional funding may be available through the city's Capital Improvement Planning process; bond authority; or other local, State, or private funding source. More information on how to mitigate for natural hazards can be found in the FEMA Local Mitigation Planning Handbook, which is accessible through http://www.fema.gov/media-library/assets/documents/31598?id=7209.

Additional information on integrating a Hazard Mitigation Plan with the local planning process is accessible through http://www.fema.gov/media-library/assets/documents/19261?id=4267.

City of Lakewood: Areas of Mitigation Interest and Recommended Resilience Strategies

Based on the Hazus risk assessment, the project team completed an overall hazard assessment for the county that includes the buildings most impacted by one or more hazards. Table 43 highlights some of the buildings that are affected by earthquake in the City of Lakewood.

Table 43: Areas of Mitigation Interest for City of Lakewood

COMMUNITY FACILITY	ADDRESS	BUILDING VALUE	LOSS VALUE	LOSS RATIO	HAZARD TYPE
LAKES HIGH SCHOOL	10320 FARWEST DR SW	$53.0M	$1.8M	3.4%	EARTHQUAKE

COMMUNITY FACILITY	ADDRESS	BUILDING VALUE	LOSS VALUE	LOSS RATIO	HAZARD TYPE
CUSTER ELEMENTARY SCHOOL / HUDTLOFF MIDDLE SCHOOL*	7801 STEILACOOM BLVD SW / 8102 PHILLIPS ROAD SW	$17.M	$607.8K	3.4%	EARTHQUAKE
LAKEWOOD POLICE DEPARTMENT	9401 LAKEWOOD DRIVE SW	$9.6M	$323.3K	3.4%	EARTHQUAKE
CLOVER PARK TECHNICAL COLLEGE – MAIN CAMPUS / FOUR HEROES ELEMENTARY SCHOOL / HARRISON PREPARATORY SCHOOL*	4500 STEILACOOM BLVD SW / 9101 LAKEWOOD DR SW / 9103 LAKEWOOD DR SW	$60.8M	$2.0M	3.3%	EARTHQUAKE

*Facilities share the same UDF Parcel

Hazard Mitigation Plan Analysis

The Pierce County Hazard Mitigation Plan, effective through July 23, 2020, includes the City of Lakewood and identifies the hazard mitigation projects, shown in Table 44, that can be aided by the information in this Risk Report.

Table 44: Hazard Mitigation Plan Analysis for City of Lakewood

HAZARD	PROJECTS	ADDITIONAL INFORMATION FROM RISK REPORT
Multi-hazard	Identify critical routes and determine alternate routes.	Utilize Risk Report and Risk Database to identify isolated areas and determine routes that will remain operational after an event.
Earthquake	Review the city's bridges, culverts, and retaining walls for seismic vulnerability.	Utilize Risk Report and Risk Database to prioritize the bridges most in need of seismic retrofit or replacement.

Recommended Resilience Strategies

Based on the assessment above, FEMA recommends the strategies shown in Table 45.

Table 45: Recommended Resilience Strategies for City of Lakewood

PROBLEM STATEMENT	RECOMMENDED STRATEGIES
Lakewood has 70.2 percent of its structures built before modern building codes. This could result in significant damage during an earthquake.	• Develop a priority list for essential facility earthquake retrofits. • Develop an outreach strategy or mitigation program for homeowners or businesses to retrofit older buildings

While Federal funding for the above projects is limited, FEMA recommends incorporating these projects into the county's Natural Hazards Mitigation Plan should disaster funds become available. Additional funding may be available through the city's Capital Improvement Planning process; bond authority; or other local, State, or private funding source. More information on how to mitigate for natural hazards can be found in the FEMA Local Mitigation Planning Handbook, which is accessible through http://www.fema.gov/media-library/assets/documents/31598?id=7209.

Additional information on integrating a Hazard Mitigation Plan with the local planning process which is accessible through http://www.fema.gov/media-library/assets/documents/19261?id=4267.

City of Milton: Areas of Mitigation Interest and Recommended Resilience Strategies

Based on the Hazus risk assessment, the project team completed an overall hazard assessment for the county that includes the buildings most impacted by one or more hazards. Table 46 highlights some of the buildings that are affected by earthquake, flood, lahar, and volcano in the City of Milton.

Table 46: Areas of Mitigation Interest for City of Milton

COMMUNITY FACILITY	ADDRESS	BUILDING VALUE	LOSS VALUE	LOSS RATIO	HAZARD TYPE
MILTON POLICE DEPARTMENT	1000 LAUREL ST	$222.7K	$21.6K	9.7%	EARTHQUAKE, VOLCANO / LAHAR
EAST PIERCE FIRE & RESCUE – STATION 124 (VOLUNTEER)	1000 LAUREL ST	$1.2M	$101.4K	8.6%	EARTHQUAKE
DISCOVERY PRIMARY SCHOOL – MILTON / ENDEAVOUR INTERMEDIATE SCHOOL / SURPRISE LAKE MIDDLE SCHOOL*	1205 19TH AV	$12.8M	$660.5K	5.2%	EARTHQUAKE
I LAKE MEDICAL CLINIC	2748 MILTON WAY	$3.9M	$196.5K	5.0%	EARTHQUAKE
7 RESIDENTIAL STRUCTURES	23rd AVENUE	$1.6M	$80.7K	5.0%	FLOOD

*Facilities share the same UDF Parcel

Hazard Mitigation Plan Analysis

The Pierce County Hazard Mitigation Plan, effective through July 23, 2020, includes the City of Milton and identifies the hazard mitigation projects, shown in Table 47, that can be aided by the information in this Risk Report.

Table 47: Hazard Mitigation Plan Analysis for City of Milton

HAZARD	PROJECTS	ADDITIONAL INFORMATION FROM RISK REPORT
Flood	Identify and mitigate flood-prone property.	Utilize Risk Report and Risk Database to identify and prioritize structures with flood risk and develop a strategy to mitigate flooding.
Earthquake	Identify and mitigate city-owned infrastructure in need of seismic replacement/retrofit.	Utilize Risk Report and Risk Database to identify and prioritize infrastructure in need of seismic retrofit or replacement.

Recommended Resilience Strategies

Based on the assessment above, FEMA recommends the strategies shown in Table 48.

Table 48: Recommended Resilience Strategies for City of Milton

PROBLEM STATEMENT	RECOMMENDED STRATEGIES
Milton's essential facilities are at risk during a Tacoma Fault M7.1 earthquake, leaving 100 percent of police and fire facilities non-functional following the event.	• Develop a priority list for essential facility earthquake retrofits. • Develop contingencies in the case of essential facility failure.
16 percent of Milton's structures, worth over $72M, are located in the volcano hazard area.	• Provide outreach to homeowners regarding the volcano risk. • Consider limiting additional development in volcano hazard zones. • Move essential facilities and infrastructure out of volcano hazard zones. • Check volcano evacuation routes for post-event functionality.
Milton has 32 properties located in the floodplain.	• Provide outreach to homeowners regarding flood risk and the benefits of flood insurance.

While Federal funding for the above projects is limited, FEMA recommends incorporating these projects into the county's Natural Hazards Mitigation Plan should disaster funds become available. Additional funding may be available through the city's Capital Improvement Planning process; bond authority; or other local, State, or private funding source. More information on how to mitigate for natural hazards can be found in the FEMA Local Mitigation Planning Handbook, which is accessible through http://www.fema.gov/media-library/assets/documents/31598?id=7209.

Additional information on integrating a Hazard Mitigation Plan with the local planning process is accessible through http://www.fema.gov/media-library/assets/documents/19261?id=4267.

City of Orting: Areas of Mitigation Interest and Recommended Resilience Strategies

Based on the Hazus risk assessment, the project team completed an overall hazard assessment for the county that includes the buildings most impacted by one or more hazards. Table 49 highlights some of the buildings that are affected by earthquake, flood, and volcano in the City of Orting.

Table 49: Areas of Mitigation Interest for City of Orting

COMMUNITY FACILITY	ADDRESS	BUILDING VALUE	LOSS VALUE	LOSS RATIO	HAZARD TYPE
ORTING MIDDLE SCHOOL	111 WHITEHAWK BLVD NW	$17.4M	$715.6K	4.1%	EARTHQUAKE, LIQUEFACTION, VOLCANO / LAHAR
ORTING HIGH SCHOOL / ORTING PRIMARY SCHOOL*	320 WASHINGTON AVE N / 316 WASHINGTON AVE N	$13.7M	$467.7K (EQ)	3.4%(EQ)	EARTHQUAKE, FLOOD***, LIQUEFACTION, VOLCANO / LAHAR
ORTING VALLEY FIRE & RESCUE - STATION 40 (HEADQUARTERS) / ORTING POLICE DEPARTMENT	401 WASHINGTON AVE SE	Unknown	**	**	LIQUEFACTION, VOLCANO / LAHAR
PTARMIGAN RIDGE INTERMEDIATE SCHOOL	805 OLD PIONEER WAY E	Unknown	**	**	LIQUEFACTION, VOLCANO / LAHAR
ORTING WASTE TREATMENT PLANT	902 ROCKY ROAD NE	$5.9M	**	**	FLOOD
RESIDENTIAL	DAFFODIL AVE NE	$396.6K	$6.4K (EQ)	1.6% (EQ)	EARTHQUAKE, FLOOD, LIQUEFACTION, VOLCANO / LAHAR
RESIDENTIAL	NEAR DEEDED ST	$775.4K	$9.7K (EQ)	1.3%(EQ)	EARTHQUAKE, FLOOD, LIQUEFACTION, VOLCANO / LAHAR

COMMUNITY FACILITY	ADDRESS	BUILDING VALUE	LOSS VALUE	LOSS RATIO	HAZARD TYPE
AGRICULTURAL	BY CHRISTIAN LN SE	$58.2K	$704 (EQ)	1.2% (EQ)	EARTHQUAKE, FLOOD, LIQUEFACTION, VOLCANO / LAHAR

*Facilities share the same UDF Parcel
**Data not available
***Flood Hazard identified for Orting High School

Hazard Mitigation Plan Analysis

The Pierce County Hazard Mitigation Plan, effective through July 23, 2020, includes the City of Orting and identifies the hazard mitigation projects, shown in Table 50, that can be aided by the information in this Risk Report.

Table 50: Hazard Mitigation Plan Analysis for City of Orting

HAZARD	PROJECTS	ADDITIONAL INFORMATION FROM RISK REPORT
Earthquake	Develop and implement a program to assess and retrofit city infrastructure.	Utilize Risk Report and Risk Database to identify infrastructure most in need of seismic retrofit or replacement.
Volcano/Lahar	Continue lahar evacuation drills.	Utilize Risk Report and Risk Database to confirm the safety of the current evacuation route and identify structures at risk of lahar to discuss during the after-action evacuation drill.

Recommended Resilience Strategies

Based on the assessment above, FEMA recommends the strategies shown in Table 51.

Table 51: Recommended Resilience Strategies for City of Orting

PROBLEM STATEMENT	RECOMMENDED STRATEGIES
100 percent of Orting's structures, worth over $444M, are located in the volcano hazard area.	• Provide outreach to homeowners regarding the volcano risk. • Consider limiting additional development in volcano hazard zones. • Move essential facilities and infrastructure in volcano hazard zones. • Check volcano evacuation routes for post-event functionality. • Develop a public awareness campaign for lahar risk and a program for residents to put together preparedness kits. • Explore options for solar or an alternatively powered lahar siren. • Develop a lahar evacuation procedure specifically for the Orting School District.
100 percent of Orting's structures are located in the moderate or higher liquefaction zone and 20.7 percent were built before modern building codes.	• Develop a priority list for essential facility earthquake retrofits, including the water supply system. • Retrofit older schools and City Hall. Develop an outreach strategy or mitigation program for homeowners or businesses to retrofit older buildings. • Facilitate information sharing and communication between Puget Sound Energy and the city to develop an emergency response plan.
Orting has 354 structures in the SFHA, but only 306 flood policies, posing a significant risk to annual flooding events.	• Develop an outreach strategy to help homeowners, realtors, and insurance agents understand the value of flood insurance.

While Federal funding for the above projects is limited, FEMA recommends incorporating these projects into the county's Natural Hazards Mitigation Plan should disaster funds become available. Additional funding may be available through the city's Capital Improvement Planning process; bond authority; or other local, State, or private funding source. More information on how to mitigate for natural hazards can be found in the FEMA Local Mitigation Planning Handbook, which is accessible through http://www.fema.gov/media-library/assets/documents/31598?id=7209.

Additional information on integrating a Hazard Mitigation Plan with the local planning process is accessible through http://www.fema.gov/media-library/assets/documents/19261?id=4267.

City of Pacific: Areas of Mitigation Interest and Recommended Resilience Strategies

Based on the Hazus risk assessment, the project team completed an overall hazard assessment for the county that includes the buildings most impacted by multiple hazards. No essential facilities within the City of Pacific were available for the Hazus risk assessment, because most of the city is in King County.

Hazard Mitigation Plan Analysis

The King County Hazard Mitigation Plan, effective through May 1, 2020, includes the City of Pacific and identifies the hazard mitigation projects, shown in Table 52, that can be aided by the information in this Risk Report.

Table 52: Hazard Mitigation Plan Analysis for City of Pacific

HAZARD	PROJECTS	ADDITIONAL INFORMATION FROM RISK REPORT
Multi-hazard	Support retrofitting, purchase, or relocation of structures located in hazard-prone areas to protect structures from future damage, prioritizing repetitive loss properties.	Utilize Risk Report and Risk Database to identify structures in hazard-prone areas for retrofit, purchase, or relocation.
Earthquake	Enforce the city's building codes and zoning ordinances to prevent or minimize damage from hazard events.	Utilize Risk Report and Risk Database to highlight the importance of building code enforcement.
Earthquake	Inspect and retrofit critical facilities from earthquake.	Utilize Risk Report and Risk Database to identify at-risk facilities for future seismic retrofit.

Recommended Resilience Strategies

Based on the assessment above, FEMA recommends the strategies shown in Table 53.

Table 53: Recommended Resilience Strategies for City of Pacific

PROBLEM STATEMENT	RECOMMENDED STRATEGIES
The City of Pacific has 158 structures at risk during an M7.1 Tacoma Fault Earthquake, representing a loss of $6.2M.	• Develop a priority list for essential facility earthquake retrofits. • Develop and distribute information to homeowners regarding retrofitting of residential structures.
98.7 percent of Pacific's structures, worth over $71.6M, are located in the volcano hazard area.	• Provide outreach to homeowners regarding the volcano risk. • Consider limiting additional development in volcano hazard zones. • Move essential facilities and infrastructure out of volcano hazard zones. • Check volcano evacuation routes for post-event functionality.

While Federal funding for the above projects is limited, FEMA recommends incorporating these projects into the county's Natural Hazards Mitigation Plan should disaster funds become available. Additional funding may be available through the city's Capital Improvement Planning process; bond authority; or other local, State, or private funding source. More information on how to mitigate for natural hazards can be found in the FEMA Local Mitigation Planning Handbook, which is accessible through http://www.fema.gov/media-library/assets/documents/31598?id=7209

Additional information on integrating a Hazard Mitigation Plan with the local planning process is accessible through http://www.fema.gov/media-library/assets/documents/19261?id=4267.

City of Puyallup: Areas of Mitigation Interest and Recommended Resilience Strategies

Based on the Hazus risk assessment, the project team completed an overall hazard assessment for the county that includes the buildings most impacted by one or more hazards. Table 54 highlights some of the buildings that are affected by earthquake, liquefaction, flood, lahar, and volcano in the City of Puyallup.

Table 54: Areas of Mitigation Interest for City of Puyallup

COMMUNITY FACILITY	ADDRESS	BUILDING VALUE	LOSS VALUE	LOSS RATIO	HAZARD TYPE
PUYALLUP HIGH SCHOOL	105 7TH ST SW	$22.8M	$2.5M	11.0%	EARTHQUAKE, LIQUEFACTION, VOLCANO / LAHAR
CENTRAL PIERCE FIRE & RESCUE – STATION 71	902 7TH STREET NW	$1.7M	$111.9K	6.4%	EARTHQUAKE, LIQUEFACTION, VOLCANO / LAHAR
KALLES JUNIOR HIGH SCHOOL	501 7TH AVE SE	$8.2M	$511.2K	6.3%	EARTHQUAKE, LIQUEFACTION, VOLCANO / LAHAR
PIERCE COLLEGE PUYALLUP	1601 39TH AVE SE	$37.1M	$1.6M	4.3%	EARTHQUAKE
GOOD SAMARITAN HOSPITAL	407 14TH AVE SOUTH	$273.0M	$7.3M	2.7%	EARTHQUAKE, LIQUEFACTION, VOLCANO / LAHAR
RESIDENTIAL STRUCTURE	NEAR 14TH ST SW	$1.4M	$43.9K	3.2% (EQ)	EARTHQUAKE, FLOOD, LIQUEFACTION
PUYALLUP WASTEWATER TREATMENT PLANT	1602 and 1604 18TH ST NW	$33.0M	**	**	FLOOD
COMMERCIAL	BETWEEN E MAIN AVE & RIVERWALK TRAIL	$12.0M	$806.2K (EQ)	6.7%(EQ)	EARTHQUAKE, FLOOD, LIQUEFACTION, VOLCANO / LAHAR

COMMUNITY FACILITY	ADDRESS	BUILDING VALUE	LOSS VALUE	LOSS RATIO	HAZARD TYPE
EDUCATIONAL	1106 SHAW RD	$7.8M	$483.0K (EQ)	6.3%(EQ)	EARTHQUAKE, FLOOD, LIQUEFACTION, VOLCANO / LAHAR
INDUSTRIAL	BETWEEN E MAIN & E PIONEER	$956.0K	$5.7K (EQ)	5.7%(EQ)	EARTHQUAKE, FLOOD, LIQUEFACTION, VOLCANO / LAHAR
RESIDENTIAL	NEAR 9TH AVE SW & 7TH AVE SW	$922.0K	$45.0K (EQ)	5.1%(EQ)	EARTHQUAKE, FLOOD, LIQUEFACTION, VOLCANO / LAHAR

Hazard Mitigation Plan Analysis

The City of Puyallup Hazard Mitigation Plan, effective through April 18, 2018, identifies the hazard mitigation projects, shown in Table 55, that can be aided by the information in this Risk Report.

Table 55: Hazard Mitigation Plan Analysis for City of Puyallup

HAZARD	PROJECTS	ADDITIONAL INFORMATION FROM RISK REPORT
Multi-hazard	Develop a Disaster Recovery Plan.	Utilize Risk Report and Risk Database to identify areas impacted by hazard events and identify facilities and transportation routes viable post-event.
Multi-hazard	Deliver all-hazards public education campaigns.	Utilize Risk Report and Risk Database to expand the preparedness conversation to include mitigation.

Recommended Resilience Strategies

Based on the assessment above, FEMA recommends the strategies shown in Table 56.

Table 56: Recommended Resilience Strategies for City of Puyallup

PROBLEM STATEMENT	RECOMMENDED STRATEGIES
50.8 percent of Puyallup's structures, worth over $2B, are located in the volcano hazard area.	• Provide outreach to homeowners regarding the volcano risk. • Consider limiting additional development in volcano hazard zones. • Move essential facilities and infrastructure out of volcano hazard zones. • Check volcano evacuation routes for post-event functionality.
Puyallup has 40.8 percent of its structures built before modern building codes, with 55.2 percent located in the moderate to higher liquefaction zone. This could result in significant damage during an earthquake.	• Develop a priority list for essential facility earthquake retrofits. • Develop an outreach strategy or mitigation program for homeowners or businesses to retrofit older buildings.
Puyallup's essential facilities are at risk during a Tacoma Fault M7.1 earthquake, leaving 12.5 percent of school facilities non-functional following the event.	• Develop a priority list for essential facility earthquake retrofits. • Retrofit water tank facilities and water supply infrastructure. • Develop contingencies in the case of essential facility failure.
Puyallup has over 400 properties in the floodplain, but only 374 total flood insurance policies.	• Develop and distribute outreach materials to home and business owners with properties in the floodplain highlighting flood mitigation strategies and the benefits of flood insurance.

While Federal funding for the above projects is limited, FEMA recommends incorporating these projects into the city's Natural Hazards Mitigation Plan should disaster funds become available. Additional funding may be available through the city's Capital Improvement Planning process; bond authority; or other local, State, or private funding source. More information on how to mitigate for natural hazards can be found in the FEMA Local Mitigation Planning Handbook, which is accessible through http://www.fema.gov/media-library/assets/documents/31598?id=7209.

Additional information on integrating a Hazard Mitigation Plan with the local planning process is accessible through http://www.fema.gov/media-library/assets/documents/19261?id=4267.

City of Roy: Areas of Mitigation Interest and Recommended Resilience Strategies

Based on the Hazus risk assessment, the project team completed an overall hazard assessment for the county that includes the buildings most impacted by one or more hazards. Table 57 highlights some of the buildings that are affected by earthquake in the City of Roy.

Table 57: Areas of Mitigation Interest for City of Roy

COMMUNITY FACILITY	ADDRESS	BUILDING VALUE	LOSS VALUE	LOSS RATIO	HAZARD TYPE
ROY ELEMENTARY SCHOOL	340 PETERSON ST	$2.2M	$9.0K	<1%	EARTHQUAKE

COMMUNITY FACILITY	ADDRESS	BUILDING VALUE	LOSS VALUE	LOSS RATIO	HAZARD TYPE
SOUTH PIERCE FIRE & RESCUE – STATION 171 (STAFFED)	302 MCNAUGHT ST	$344.3K	$1.3K	<1%	EARTHQUAKE
ROY POLICE DEPARTMENT	216 S MCNAUGHT ST	$431.0K	$1.6K	<1%	EARTHQUAKE

Hazard Mitigation Plan Analysis

The Pierce County Hazard Mitigation Plan, effective through July 23, 2020, includes the City of Roy and identifies the hazard mitigation projects, shown in Table 58, that can be aided by the information in this Risk Report.

Table 58: Hazard Mitigation Plan Analysis for City of Roy

HAZARD	PROJECTS	ADDITIONAL INFORMATION FROM RISK REPORT
Multi-hazard	Identify critical facilities, infrastructure, and assets within the city.	Utilize Risk Report and Risk Database to identify critical facilities and impacts after a hazard event.
Multi-hazard	Develop alternate routes through the city in the event of a long-term closure of I-5.	Utilize Risk Report and Risk Database to identify viable and functional transportation routes following an event.
Multi-hazard	Educate the community on natural and man-made hazards.	Utilize Risk Report and Risk Database information to inform the community and start conversations about the benefits of mitigation.

Recommended Resilience Strategies

Based on the assessment above, FEMA recommends the strategies shown in Table 59.

Table 59: Recommended Resilience Strategies for City of Roy

PROBLEM STATEMENT	RECOMMENDED STRATEGIES
Roy has 57.4 percent of its structures built before modern building codes. This could result in significant damage during an earthquake.	• Develop a priority list for essential facility earthquake retrofits. • Develop an outreach strategy or mitigation program for homeowners or businesses to retrofit older buildings.

While Federal funding for the above projects is limited, FEMA recommends incorporating these projects into the county's Natural Hazards Mitigation Plan should disaster funds become available. Additional funding may be available through the city's Capital Improvement Planning process; bond authority; or

other local, State, or private funding source. More information on how to mitigate for natural hazards can be found in the FEMA Local Mitigation Planning Handbook, which is accessible through http://www.fema.gov/media-library/assets/documents/31598?id=7209.

Additional information on integrating a Hazard Mitigation Plan with the local planning process is accessible through http://www.fema.gov/media-library/assets/documents/19261?id=4267.

Town of Ruston: Areas of Mitigation Interest and Recommended Resilience Strategies

Based on the Hazus risk assessment, the project team completed an overall hazard assessment for the county that includes the buildings most impacted by one or more hazards. Table 60 highlights some of the buildings that are affected by earthquake and liquefaction in the Town of Ruston.

Table 60: Areas of Mitigation Interest for Town of Ruston

COMMUNITY FACILITY	ADDRESS	BUILDING VALUE	LOSS VALUE	LOSS RATIO	HAZARD TYPE
RUSTON POLICE DEPARTMENT	5219 N SHIRLEY ST	$356.9K	$31.0K	8.7%	EARTHQUAKE
RUSTON MUNICIPAL COURT/TOWN HALL	5117 N WINNIFRED	$235.1K	$15.8K	6.7% (EQ)	EARTHQUAKE, LIQUEFACTION

Hazard Mitigation Plan Analysis

The Town of Ruston does not have an approved Hazard Mitigation Plan. FEMA strongly recommends that the town develop a plan using information from this Risk Report.

Recommended Resilience Strategies

Based on the assessment above, FEMA recommends the strategies shown in Table 61.

Table 61: Recommended Resilience Strategies for Town of Ruston

PROBLEM STATEMENT	RECOMMENDED STRATEGIES
Ruston has 48.6 percent of structures built before modern building codes and is subject to up to $6M in structural losses during an M7.1 Tacoma Fault earthquake.	• Develop a priority list for essential facility earthquake retrofits. • Develop and distribute information to homeowners regarding retrofitting of residential structures.

While Federal funding for the above projects is limited, FEMA recommends incorporating these projects into a Natural Hazards Mitigation Plan should disaster funds become available. Additional funding may be available through the town's Capital Improvement Planning process; bond authority; or other local, State, or private funding source. More information on how to mitigate for natural hazards can be found in the FEMA Local Mitigation Planning Handbook, which is accessible through http://www.fema.gov/media-library/assets/documents/31598?id=7209.

Additional information on integrating a Hazard Mitigation Plan with the local planning process is accessible through http://www.fema.gov/media-library/assets/documents/19261?id=4267.

Town of South Prairie: Areas of Mitigation Interest and Recommended Resilience Strategies

Based on the Hazus risk assessment, the project team completed an overall hazard assessment for the county that includes the buildings most impacted by one or more hazards. Table 62 highlights some of the buildings that are affected by flood, earthquake, liquefaction, and volcano in the Town of South Prairie.

Table 62: Areas of Mitigation Interest for Town of South Prairie

COMMUNITY FACILITY	ADDRESS	BUILDING VALUE	LOSS VALUE	LOSS RATIO	HAZARD TYPE
EAST PIERCE FIRE & RESCUE – STATION 119 (VOLUNTEER)	350 SR 162	$1.1M	$48.1K	4.3%	EARTHQUAKE, FLOOD, LIQUEFACTION, VOLCANO / LAHAR

Hazard Mitigation Plan Analysis

The Pierce County Hazard Mitigation Plan, effective through July 23, 2020, includes the Town of South Prairie and identifies the hazard mitigation projects, shown in Table 63, that can be aided by the information in this Risk Report.

Table 63: Hazard Mitigation Plan Analysis Town of South Prairie

HAZARD	PROJECTS	ADDITIONAL INFORMATION FROM RISK REPORT
Multi-hazard	Assess South Prairie's capabilities and recommend specific policy actions to achieve a more disaster resistant community.	Utilize Risk Report and Risk Database to inform an assessment and highlight areas where added policy could improve the community.

Recommended Resilience Strategies

Based on the assessment above, FEMA recommends the strategies shown in Table 64.

Table 64: Recommended Resilience Strategies Town of South Prairie

PROBLEM STATEMENT	RECOMMENDED STRATEGIES
96.5 percent of South Prairie's structures, worth over $20M, are located in the volcano hazard area.	• Provide outreach to homeowners regarding the volcano risk. • Consider limiting additional development in volcano hazard zones. • Move essential facilities and infrastructure out of volcano hazard zones. • Check volcano evacuation routes for post-event functionality.
South Prairie has 85.9 percent of structures located in the moderate to high liquefaction zone, with 50.9 percent of structures built before modern building codes. This could result in significant damage during an earthquake.	• Develop a priority list for essential facility earthquake retrofits. • Develop an outreach strategy or mitigation program for homeowners or businesses to retrofit older buildings.

While Federal funding for the above projects is limited, FEMA recommends incorporating these projects into the county's Natural Hazards Mitigation Plan should disaster funds become available. Additional funding may be available through the town's Capital Improvement Planning process; bond authority; or other local, State, or private funding source. More information on how to mitigate for natural hazards can be found in the FEMA Local Mitigation Planning Handbook, which is accessible through http://www.fema.gov/media-library/assets/documents/31598?id=7209.

Additional information on integrating a Hazard Mitigation Plan with the local planning process is accessible through http://www.fema.gov/media-library/assets/documents/19261?id=4267.

Town of Steilacoom: Areas of Mitigation Interest and Recommended Resilience Strategies

Based on the Hazus risk assessment, the project team completed an overall hazard assessment for the county that includes the buildings most impacted by one or more hazards. Table 65 highlights some of the buildings that are affected by earthquake and landslide in the Town of Steilacoom.

Table 65: Areas of Mitigation Interest for Town of Steilacoom

COMMUNITY FACILITY	ADDRESS	BUILDING VALUE	LOSS VALUE	LOSS RATIO	HAZARD TYPE
CHERRYDALE PRIMARY SCHOOL	1201 GALLOWAY ST	$4.1M	$138.9K	3.4%	EARTHQUAKE
STEILACOOM HIGH SCHOOL	54 SENTINEL DR	$13.2M	$450.0K	3.4%	EARTHQUAKE
SALTARS POINT ELEMENTARY SCHOOL	908 THIRD ST	$11.2M	$381.0K	3.4%	EARTHQUAKE
STEILACOOM POLICE DEPARTMENT	601 MAIN ST	$844.8K	$11.9K	1.4%	EARTHQUAKE
RESIDENTIAL	LAFAYETTE ST	$932.1K	$12.1K	1.3%	EARTHQUAKE, LANDSLIDE
RESIDENTIAL	CHINOOK LN	$230.3K	$2.9K	1.3%	EARTHQUAKE, LANDSLIDE
COMMERCIAL	LAFAYETTE ST	$85.4K	$890	1.0%	EARTHQUAKE, LANDSLIDE

Hazard Mitigation Plan Analysis

The Pierce County Hazard Mitigation Plan, effective through July 23, 2020, includes the Town of Steilacoom and identifies the hazard mitigation projects, shown in Table 66, that can be aided by the information in this Risk Report.

Table 66: Hazard Mitigation Plan Analysis for Town of Steilacoom

HAZARD	PROJECTS	ADDITIONAL INFORMATION FROM RISK REPORT
Multi-hazard	Implement public education strategies to increase residents' awareness of pre-emergency preparedness.	Utilize Risk Report and Risk Database to inform educational material and expand and improve upon existing outreach to focus on mitigation in addition to preparedness.
Multi-hazard	Develop and implement a Continuity of Operations Plan (COOP).	Utilize Risk Report and Risk Database to inform the COOP, specifically viable transportation routes and functioning facilities.
Earthquake	Perform structural and non-structural seismic retrofits to all buildings.	Utilize Risk Report and Risk Database to prioritize the buildings most in need of seismic retrofit or replacement.

Recommended Resilience Strategies

Based on the assessment above, FEMA recommends the strategies shown in Table 67.

Table 67: Recommended Resilience Strategies for Town of Steilacoom

PROBLEM STATEMENT	RECOMMENDED STRATEGIES
Steilacoom has 161 buildings within the landslide zone, representing $58M in value.	• Provide outreach to homeowners regarding the landslide risk. • Consider limiting additional development in landslide hazard zones. • Move or harden essential facilities and infrastructure in landslide hazard zones. • Develop a buyout program for homes in landslide areas.
Steilacoom has 34.4 percent of structures built before modern building codes and 4 percent of structures located in the moderate to high liquefaction zone. This could result in significant damage during an earthquake.	• Develop a priority list for essential facility earthquake retrofits. • Develop an outreach strategy or mitigation program for homeowners or businesses to retrofit older buildings.
Significant erosion impacts Sunnyside Beach Park and threatens the railroad tracks.	• Evaluate causes and possible solutions to prevent future erosion and protect the railroad and other infrastructure.
Multiple hazards could cause multi-day disruptions in resources and support.	• Establish protocols for more than 2/3 days of fuel reserves for generators following a disaster. • Continue conducting regular outreach to homeowners to ensure residents have enough potable water post-disaster.

While Federal funding for the above projects is limited, FEMA recommends incorporating these projects into the county's Natural Hazards Mitigation Plan should disaster funds become available. Additional

funding may be available through the town's Capital Improvement Planning process; bond authority; or other local, State, or private funding source. More information on how to mitigate for natural hazards can be found in the FEMA Local Mitigation Planning Handbook, which is accessible through http://www.fema.gov/media-library/assets/documents/31598?id=7209.

Additional information on integrating a Hazard Mitigation Plan with the local planning process is accessible through http://www.fema.gov/media-library/assets/documents/19261?id=4267.

City of Sumner: Areas of Mitigation Interest and Recommended Resilience Strategies

Based on the Hazus risk assessment, the project team completed an overall hazard assessment for the county that includes the buildings most impacted by one or more hazards. Table 68 highlights some of the buildings that are affected by earthquake, liquefaction, flood, and volcano in the City of Sumner.

Table 68: Areas of Mitigation Interest for City of Sumner

COMMUNITY FACILITY	ADDRESS	BUILDING VALUE	LOSS VALUE	LOSS RATIO	HAZARD TYPE
SUMNER HIGH SCHOOL	1707 MAIN ST	$33.1M	$2.6K	7.8%	EARTHQUAKE, LIQUEFACTION, VOLCANO / LAHAR
DAFFODIL VALLEY ELEMENTARY SCHOOL	1509 VALLEY AVE	$11.6M	$904.9K	7.8%	EARTHQUAKE, LIQUEFACTION, VOLCANO / LAHAR
SUMNER POLICE DEPARTMENT	1104 MAPLE ST	$4.5M	$335.2K	7.5%	EARTHQUAKE, LIQUEFACTION, VOLCANO / LAHAR
SUMNER MIDDLE SCHOOL	1508 WILLOW ST	$14.7M	$968.0K	6.6%	EARTHQUAKE, LIQUEFACTION, VOLCANO / LAHAR
EAST PIERCE FIRE & RESCUE – STATION 113	800 HARRISON ST	$110.6K	$4.2K	3.8%	EARTHQUAKE, LIQUEFACTION, VOLCANO / LAHAR
COMMERCIAL	NEAR 140TH AVE E	$3.4M	$331.1K (EQ)	9.8%(EQ)	EARTHQUAKE, FLOOD, LIQUEFACTION, VOLCANO / LAHAR
AGRICULTURAL	NEAR 140TH AVE CT E	$166.7K	$8.0K (EQ)	4.8%(EQ)	EARTHQUAKE, FLOOD, LIQUEFACTION, VOLCANO / LAHAR

COMMUNITY FACILITY	ADDRESS	BUILDING VALUE	LOSS VALUE	LOSS RATIO	HAZARD TYPE
RESIDENTIAL	NEAR 29TH ST E	$145.4K	$6.7K (EQ)	4.6%(EQ)	EARTHQUAKE, FLOOD, LIQUEFACTION, VOLCANO / LAHAR

Hazard Mitigation Plan Analysis

The Pierce County Hazard Mitigation Plan, effective through July 23, 2020, includes the City of Sumner and identifies the hazard mitigation projects, shown in Table 69, that can be aided by the information in this Risk Report.

Table 69: Hazard Mitigation Plan Analysis for City of Sumner

HAZARD	PROJECTS	ADDITIONAL INFORMATION FROM RISK REPORT
Multi-hazard	Select properties for acquisition while considering all hazard risk for potential locations.	Utilize Risk Report and Risk Database to identify properties and infrastructure at risk.
Multi-hazard	Develop a Disaster Recovery Plan.	Utilize Risk Report and Risk Database to inform the plan and link recovery to mitigation issues effectively.
Earthquake	Continue Bridge Retrofit Program for bridges in need of seismic retrofit and/or replacement.	Utilize Risk Report and Risk Database to prioritize the bridges most in need of seismic retrofit or replacement.
Earthquake	Evaluate critical facilities to determine earthquake structural integrity.	Utilize Risk Report and Risk Database to prioritize retrofits for identified at-risk structures.

Recommended Resilience Strategies

Based on the assessment above, FEMA recommends the strategies shown in Table 70.

Table 70: Recommended Resilience Strategies for City of Sumner

PROBLEM STATEMENT	RECOMMENDED STRATEGIES
Sumner has 99.3 percent of structures located in the moderate or higher liquefaction zone, representing a loss of nearly $81M during an M7.1 Tacoma Fault Earthquake.	• Develop a priority list for essential facility earthquake retrofits. • Develop and distribute information to homeowners regarding retrofitting of residential structures.
Sumner's essential facilities are at risk during a Tacoma Fault M7.1 earthquake, leaving 100 percent of fire facilities and 66.7 percent of schools non-functional following the event.	• Develop a priority list for essential facility earthquake retrofits. • Develop contingencies in the case of essential facility failure.

PROBLEM STATEMENT	RECOMMENDED STRATEGIES
99.6 percent of Sumner's structures, worth over $1.3B, are located in the volcano hazard area.	• Provide outreach to homeowners regarding the volcano risk. • Consider limiting additional development in volcano hazard zones. • Move essential facilities and infrastructure out of volcano hazard zones. • Check volcano evacuation routes for post-event functionality.
Sumner is at risk to flooding from the White River.	• Develop the White River Restoration Project.

While Federal funding for the above projects is limited, FEMA recommends incorporating these projects into the county's Natural Hazards Mitigation Plan should disaster funds become available. Additional funding may be available through the city's Capital Improvement Planning process; bond authority; or other local, State, or private funding source. More information on how to mitigate for natural hazards can be found in the FEMA Local Mitigation Planning Handbook, which is accessible through http://www.fema.gov/media-library/assets/documents/31598?id=7209.

Additional information on integrating a Hazard Mitigation Plan with the local planning process is accessible through http://www.fema.gov/media-library/assets/documents/19261?id=4267.

City of Tacoma: Areas of Mitigation Interest and Recommended Resilience Strategies

Based on the Hazus risk assessment, the project team completed an overall hazard assessment for the county that includes the buildings most impacted by one or more hazards. Table 71 highlights some of the buildings that are affected by tsunami, earthquake, flood, volcano, and liquefaction in the City of Tacoma.

Table 71: Areas of Mitigation Interest for City of Tacoma

COMMUNITY FACILITY	ADDRESS	BUILDING VALUE	LOSS VALUE	LOSS RATIO	HAZARD TYPE
SCIENCE AND MATH INSTITUTE	5501 N PEARL ST	$513.5K	$110.0K	21.4%	EARTHQUAKE
CRESCENT HEIGHTS ELEMENTARY SCHOOL / MEEKER MIDDLE SCHOOL*	4110 NASSAU AVE NE / 4402 NASSAU AVE NE	$18.5M	$3.5M	18.8%	EARTHQUAKE
TACOMA FIRE DEPARTMENT - STATION 03	206 BROWNS POINT BLVD	$659.1K	$111.3K	16.9%	EARTHQUAKE
POINT DEFIANCE ELEMENTARY SCHOOL	4330 N VISSCHER ST	$6.3M	$967.1K	15.4%	EARTHQUAKE
SHERMAN ELEMENTARY SCHOOL	4415 N 38TH ST	$8.1M	$1.1M	13.0%	EARTHQUAKE

COMMUNITY FACILITY	ADDRESS	BUILDING VALUE	LOSS VALUE	LOSS RATIO	HAZARD TYPE
FRANCISCAN HEALTH OCCUPATIONAL HEALTH	1930 PORT OF TACOMA ROAD	$943.8K	$91.6K	9.7%	EARTHQUAKE, LIQUEFACTION, TSUNAMI, VOLCANO / LAHAR
CUMMINGS PARK	3939 RUSTON WAY	$682.4K	$345.3K (FL)	50.6%	FLOOD, TSUNAMI
INDUSTRIAL	NEAR PORT OF TACOMA RD	$3.9M	$191.3K (EQ)	8.2% (EQ)	EARTHQUAKE, FLOOD, LIQUEFACTION, TSUNAMI, VOLCANO / LAHAR
COMMERCIAL	NEAR MARINE VIEW DR & EAST SIDE DR	$653.1K	$52.3K (EQ)	8.0%	EARTHQUAKE, LANDSLIDE
RESIDENTIAL	MARINE VIEW DR	$155.9K	$11.0K (EQ)	7.0%	EARTHQUAKE, LANDSLIDE, LIQUEFACTION

*Facilities share the same UDF Parcel

Hazard Mitigation Plan Analysis

The Pierce County Hazard Mitigation Plan, effective through July 23, 2020, includes the City of Tacoma and identifies the hazard mitigation projects, shown in Table 72, that can be aided by the information in this Risk Report.

Table 72: Hazard Mitigation Plan Analysis for City of Tacoma

HAZARD	PROJECTS	ADDITIONAL INFORMATION FROM RISK REPORT
Earthquake	Conduct a seismic analysis of the city's fire stations.	Utilize Risk Report and Risk Database to identify fire stations in need of seismic retrofit or replacement.

Recommended Resilience Strategies

Based on the assessment above, FEMA recommends the strategies shown in Table 73.

Table 73: Recommended Resilience Strategies for City of Tacoma

PROBLEM STATEMENT	RECOMMENDED STRATEGIES
Tacoma has 23.9 percent of structures built before modern building codes, significantly increasing the risk from an M7.1 Tacoma Fault Earthquake, with structural losses of $826M possible.	• Develop a priority list for essential facility earthquake retrofits using rapid visual screening. • Develop an outreach strategy or mitigation program for homeowners or businesses to retrofit older buildings.

PROBLEM STATEMENT	RECOMMENDED STRATEGIES
Tacoma's essential facilities are at risk during an M7.1 Tacoma Fault Earthquake, leaving 15.4 percent of medical facilities, 33.3 percent of police facilities, 15.4 percent of fire facilities, and 22.1 percent of schools non-functional following the event.	• Develop a priority list of essential facilities, including fire stations, for earthquake retrofits. • Develop contingencies in the case of essential facility failure. • Secure funding for seismic retrofitting of water infrastructure.
Tacoma has 185 buildings within the landslide zone, representing $83M in value.	• Provide outreach to homeowners regarding the landslide risk. • Consider limiting additional development in landslide hazard zones. • Move or harden essential facilities and infrastructure in landslide hazard zones. • Develop a buyout program for homes in landslide areas.
There are 499 buildings in Tacoma, valued at over $577M, located in the tsunami zone; only 152 of those properties have flood insurance with total coverage of about $39M.	• Develop an outreach strategy to help homeowners, realtors, and insurance agents understand the value of flood insurance for tsunami risk. • Construct a vertical evacuation structure on-site at the Port of Tacoma.
Hazard mitigation grant funds are available annually and may become available post-disaster. There is a need for facilitating a better understanding of the grants process.	• Facilitate Hazard Mitigation Assistance Training through FEMA or State of Washington EMD to cover timing and eligibility, developing applications, project implementation, etc.
There is a need to increase public preparedness for multiple hazards.	• Engage neighborhoods in disaster preparation and outreach. Identify possible shelters, meeting locations, points of contact, and different languages for outreach materials. Support this effort through FEMA risk data.

While Federal funding for the above projects is limited, FEMA recommends incorporating these projects into the county's Natural Hazards Mitigation Plan should disaster funds become available. Additional funding may be available through the city's Capital Improvement Planning process; bond authority; or other local, State, or private funding source. More information on how to mitigate for natural hazards can be found in the FEMA Local Mitigation Planning Handbook, which is accessible through http://www.fema.gov/media-library/assets/documents/31598?id=7209.

Additional information on integrating a Hazard Mitigation Plan with the local planning process is accessible through http://www.fema.gov/media-library/assets/documents/19261?id=4267.

City of University Place: Areas of Mitigation Interest and Recommended Resilience Strategies

Based on the Hazus risk assessment, the project team completed an overall hazard assessment for the county that includes the buildings most impacted by one or more hazards. Table 74 highlights some of the buildings that are affected by earthquake, liquefaction, tsunami, landslide, and flood in the City of University Place.

Table 74: Areas of Mitigation Interest for City of University Place

COMMUNITY FACILITY	ADDRESS	BUILDING VALUE	LOSS VALUE	LOSS RATIO	HAZARD TYPE
WEST PIERCE FIRE & RESCUE STATION 31 / PCSD - UNIVERSITY PLACE*	3631 DREXLER DR W	$4.6M	$234.9K	5.1%	EARTHQUAKE
UNIVERSITY PLACE CLINIC - FRANCISCAN	7210 40TH ST W, STE 100	$3.7M	$140.4K	3.8%	EARTHQUAKE
PRIVATE HEALTHCARE	HEAR HILLTOP	$1.5M	$39.5K	2.6%	EARTHQUAKE
UNIVERSITY PLACE PRIMARY SCHOOL	2708 GRANDVIEW DR W	$10.0M	$252.3K	2.5%	EARTHQUAKE
PRIVATE EDUCATION	NEAR BRIDGEPORT WAY W & 27TH ST W	$1.1M	$27.7K	2.5%	EARTHQUAKE
COMMERCIAL	91ST AVE W	$946.8K	$35.0K	3.7%	EARTHQUAKE, LIQUEFACTION, TSUNAMI
RESIDENTIAL	DAY ISLAND BLVD W	$28.2K	$9.9K	3.4%	EARTHQUAKE, FLOOD, LIQUEFACTION, TSUNAMI
RESIDENTIAL	SUNSET BEACH RD W	$221.0K	$5.3K	2.4%	EARTHQUAKE, FLOOD, LANDSLIDE, LIQUEFACTION

*Facilities share the same UDF Parcel

Hazard Mitigation Plan Analysis

The City of University Place has a hazard mitigation plan that expired on April 17, 2012. FEMA strongly recommends that the city update its plan using information from this Risk Report.

Recommended Resilience Strategies

Based on the assessment above, FEMA recommends the strategies shown in Table 75.

Table 75: Recommended Resilience Strategies for City of University Place

PROBLEM STATEMENT	RECOMMENDED STRATEGIES
University Place has 134 buildings within the landslide zone, representing $44M in value.	• Provide outreach to homeowners regarding the landslide risk. • Consider limiting additional development in landslide hazard zones. • Move or harden essential facilities and infrastructure in landslide hazard zones. • Develop a buyout program for homes in landslide areas.
There are 50 buildings in University Place, valued at over $14M, located in the tsunami zone; only nine of those properties have flood insurance with total coverage of about $2.5M.	• Develop an outreach strategy to help homeowners, realtors, and insurance agents understand the value of flood insurance for tsunami risk.
University Place has 51.1 percent of structures built before modern building codes with a potential of $61M in damage from an M7.1 Tacoma Fault earthquake.	• Develop a priority list for essential facility earthquake retrofits. • Develop an outreach strategy or mitigation program for homeowners or businesses to retrofit older buildings. • Assess the Chambers Creek Bridge for potential retrofit or redevelopment.

While Federal funding for the above projects is limited, FEMA recommends incorporating these projects into a Natural Hazards Mitigation Plan should disaster funds become available. Additional funding may be available through the city's Capital Improvement Planning process; bond authority; or other local, State, or private funding source. More information on how to mitigate for natural hazards can be found in the FEMA Local Mitigation Planning Handbook, which is accessible through http://www.fema.gov/media-library/assets/documents/31598?id=7209.

Additional information on integrating a Hazard Mitigation Plan with the local planning process is accessible through http://www.fema.gov/media-library/assets/documents/19261?id=4267.

City of Wilkeson: Areas of Mitigation Interest and Recommended Resilience Strategies

Based on the Hazus risk assessment, the project team completed an overall hazard assessment for the county that includes the buildings most impacted by one or more hazards. Table 76 highlights some of the buildings that are affected by volcano, earthquake, flood, liquefaction, and lahar in the City of Wilkeson.

Table 76: Areas of Mitigation Interest for City of Wilkeson

COMMUNITY FACILITY	ADDRESS	BUILDING VALUE	LOSS VALUE	LOSS RATIO	HAZARD TYPE
RESIDENTIAL	BRIERHILL BLVD	$101.4K	$1.0K (EQ)	1.0%(EQ)	EARTHQUAKE, FLOOD, VOLCANO / LAHAR

COMMUNITY FACILITY	ADDRESS	BUILDING VALUE	LOSS VALUE	LOSS RATIO	HAZARD TYPE
RESIDENTIAL	NEAR CARBONADO SOUTH PRAIRIE RD	$177.3K	$1.7K (EQ)	1.0%	EARTHQUAKE, LIQUEFACTION, VOLCANO / LAHAR
WILKESON ELEMENTARY SCHOOL	640 RAILROAD AVE	**	**	**	VOLCANO / LAHAR
WILKESON FIRE STATION 35	501 CHURCH ST	**	**	**	VOLCANO / LAHAR

**Data not available

Hazard Mitigation Plan Analysis

The Pierce County Hazard Mitigation Plan, effective through July 23, 2020, includes the City of Wilkeson and identifies the hazard mitigation projects, shown in Table 77, that can be aided by the information in this Risk Report.

Table 77: Hazard Mitigation Plan Analysis for City of Wilkeson

HAZARD	PROJECTS	ADDITIONAL INFORMATION FROM RISK REPORT
Earthquake	Perform a seismic analysis of all city infrastructure.	Utilize Risk Report and Risk Database results to assess the seismic vulnerability of the city's infrastructure and prioritize retrofits.
Earthquake	Conduct a seismic analysis of transportation infrastructure that the city depends upon, including bridges and roads.	Utilize Risk Report and Risk Database to identify transportation infrastructure that will remain functional following an event.

Recommended Resilience Strategies

Based on the assessment above, FEMA recommends the strategies shown in Table 78.

Table 78: Recommended Resilience Strategies for City of Wilkeson

PROBLEM STATEMENT	RECOMMENDED STRATEGIES
Wilkeson has 62.2 percent of its structures built before modern building codes, with 1.5 percent in the moderate to high liquefaction zone. This could result in significant damage during an earthquake.	• Develop a priority list for essential facility earthquake retrofits. • Develop an outreach strategy or mitigation program for homeowners or businesses to retrofit older buildings. • Conduct outreach with residents to increase awareness about what to do before, during, and after an event.

PROBLEM STATEMENT	RECOMMENDED STRATEGIES
99.5 percent of Wilkeson's structures, worth $26.5M, are located in the volcano hazard area.	• Provide outreach to homeowners regarding the volcano risk. • Consider limiting additional development in volcano hazard zones. • Move essential facilities and infrastructure in volcano hazard zones. • Check volcano evacuation routes for post-event functionality.

While Federal funding for the above projects is limited, FEMA recommends incorporating these projects into the county's Natural Hazards Mitigation Plan should disaster funds become available. Additional funding may be available through the city's Capital Improvement Planning process; bond authority; or other local, State, or private funding source. More information on how to mitigate for natural hazards can be found in the FEMA Local Mitigation Planning Handbook, which is accessible through http://www.fema.gov/media-library/assets/documents/31598?id=7209.

Additional information on integrating a Hazard Mitigation Plan with the local planning process is accessible through http://www.fema.gov/media-library/assets/documents/19261?id=4267.

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Appendix

Hazus Methodology

This appendix provides documentation of the methodology for the Hazus-MH data update and Hazus Flood and Earthquake analyses that were used by the project team to highlight the loss estimations for the communities of Pierce County.

Disclaimer: The model referenced in this document does not replace or supersede any other official document or product generated to meet the requirements of any State, Federal, or local program. It is intended for planning purposes only. This document and its contents have been prepared and are intended solely for Pierce County's information and use. STARR 2 assumes no responsibility to any other party in respect of or arising out of or in connection with this document and/or its contents.

Geographic Information System Layers

The Hazus-MH General Building Stock (GBS) data are reported by U.S. Census block (flood model) or tract (earthquake model). Because the GBS data are generalized by geographic boundaries, they are referred to as aggregate data and limit the loss estimation analyses for small communities that require consideration of each building in the analyses. Therefore, the individual building data were prepared using the county assessor data, commonly called User Defined Facilities (UDFs), and were incorporated into Hazus, which allows losses to be reported at the building level. The essential facilities (EFs) and GBS data were also updated ("Level 2") using the UDFs.

User Defined Facility (UDF) Layer

The main input source for the Hazus-formatted UDF data is county assessor (or parcel) data. Building footprints were available in some areas. The assessor data, however, had to be reformatted and/or evaluated for the missing information, such as tax exempt properties (government, nonprofit organizations, etc.). STARR 2 prepared complete Hazus-formatted UDF data using the following order:

Earthquake

1. Received building physical information and building value from the county's parcel data.
2. Generated centroids from parcel data (where improvement values are available), thus approximating building locations. Parcels without improvement values were not used for this analysis.
3. Consolidated repeated parcel numbers based on building values and areas using a UDF input correction procedure.
4. Simulated a user-defined M7.1 Tacoma Fault Earthquake.

Flood

1. Received building physical information and building value from the county's parcel data.
2. Used building footprints in proximity to the Special Flood Hazard Area (SFHA) (where available) to generate centroids. If more than one building was on a parcel, the largest structure was used to populate the centroid. For areas without building footprints, centroids were generated from parcel data (where improvement values are available), thus approximating building locations.
3. Consolidated repeated parcel numbers based on building values and areas using a UDF input correction procedure.

4. Simulated a 1-percent-annual-chance flood hazard event using the 1-percent-annual-chance coastal flood depth grid.

Coastal Flood

Background:

1. The Address Points contain the Parcel ID, a vital field to link assessor data to.
2. The Address Points were spatially joined to the Structure footprints.
3. The Structure footprints were then clipped to the intersection of SFHA, Depth Grid extent, and Census Tract area.
4. The Structure footprints were converted to a point feature (a centroid that is inside the polygon).
5. Of the 929 initial structures, 837 intersect the SFHA, Depth Grid extent, and Census Tract area. Of the 837 structure points available for the Hazus flood assessment, five did not have parcel numbers to join assessor data. 832 structure points remained for the analysis.
6. Of the 832 structure points, 713 were able to be fully populated with assessor attributes.
7. In Hazus, 39 structure points fell outside of the project area (by very slim margins). The result was 674 structures with a loss output.
8. Of the 674 structures, 276 structures had no losses (most likely due to the assumed first floor elevation being greater than the flood depth elevation). Loss values are available for 398 structures.

Attributes:

Of the 832 structure points, 713 were able to be fully populated.

UD_CITY – Using the DFIRM political feature, the political boundary that the point falls within was attributed accordingly.

OCCUPANCY - Utilized IMPROVEMENT Table, PRIMARY OCCUPANCY DESCRIPTION

RES1 – SINGLE FAMILY DWELLING: Single Family Residential; Miscellaneous OB; Townhouse

RES2 – MOBILE HOME: Mobile Home

RES3A – MULTI-FAMILY DWELLING (DUPLEX): Duplex, Duplex Conv

RES3B – MULTI-FAMILY DWELLING (3-4 Units): Triplex

RES3D – MULTI-FAMILY DWELLING (10-19 UNITS): Apt Low Rise up to 19 Units; Condo Low Rise

RES4 – TEMPORARY LODGING: Motel

COM1 – RETAIL TRADE: C-Store w/Gas; Gen Warehouse up to 19,999 SF (Commercial); Gen Warehouse 20,000 to 199,999 SF (Commercial); Mini Storage; Retail Stand Alone; Storage – Material; Storage Warehouse

COM4 – BUSINESS, PROFESSIONAL, TECHNICAL SERVICES: Gen Warehouse 20,000 to 199,999 SF (Industrial); Office Building; Office Class A, Office Class C

COM8 – ENTERTAINMENT & RECREATION: Marina, Marine Hangar; Recreational; Restaurant

GOV2 – EMERGENCY RESPONSE: Government (Commercial)

IND2 – LIGHT INDUSTRIAL: Light Industrial

IND4 – METALS AND MINERALS PROCESSING: Government (Industrial)

COST_BUILDING – Utilized TAX ACCOUNT Table, IMPROVEMENT VALUE – CURRENT YEAR Field. Joined by Parcel Number. Of the 832 structures, 108 do not have an improvement value associated with the parcel.

COST_CONTENTS – The following assumptions are made:

Occupancy Code	Contents Value (percent of Building Value)
RES1 – RES6, COM10	50%
COM1-COM5, COM8-COM9, IND6, AGR1, REL1, GOV1, EDU1	100%
COM6-COM7, IND1-IND5, GOV2, EDU2	150%

SQ_FT – Utilized IMPROVEMENT Table, SQUARE FEET Field. In some instances, there is more than one value per parcel (multiple structures on the property). The following was assumed: If a parcel has more than one building, then the max square footage was used. For structures with a square footage of 1, the building footprint square footage was used and multiplied by the number of stories.

YEARBUILD – Utilized IMPROVEMENT BUILT-AS Table, ADJUSTED YEAR BUILT Field. The Adjusted Year Built table provides an adjusted year built based on significant improvements to the property that would effectively reduce the age of the building. If an Adjusted Year Built value was not available, the Year Built Field was utilized.

NUMSTORIES – Utilized IMPROVEMENT BUILT-AS Table, STORIES Field. A parcel attributed with zero stories was revised to one. Parcels with half stories were rounded up to the next full story.

DESIGN LEVEL – Utilized YEARBUILD

1 (Pre 1950), 2 (1950-1970), 3 (Post 1970), 0 (No Data available)

BLDGTYPE – Utilized IMPROVEMENT BUILT-AS Table, EXTERIOR Field.

Concrete: Masonry Concrete Block

Masonry: Masonry Common Brick, Masonry Concrete Block

Wood: Cedar Cabin, Finished Cottage, Frame Rustic Log, Frame Siding, Frame Stucco, Frame Vinyl, Hardboard Sheet, Lap Siding, Log, Pine Finished Cabin, Pine Unfinished Cabin, Unfinished Cottage, Remaining Null Values

FOUNDATIONTYPE – Utilized IMPROVEMENT Table, PRIMARY OCCUPANCY DESCRIPTION and BASEMENT SQUARE FEET Fields.

2 (Pier): If Primary Occupancy Description = Marina

4 (Basement)*: If Basement Square Feet > 0

5 (Crawlspace): If Primary Occupancy Description = Apt Low Rise up to 19 Units, Condo Low Rise, Duplex, Residential, Miscellaneous OB, Mobile Home, or Triplex, and Basement Square Feet = 0, and Stories are a whole number;

7 (Slab on Grade): If Stories include 0.5 and Basement Square Feet = 0; If Primary Occupancy Description = C-Store w/Gas, Gen Warehouse, Government, Light Industrial, Marine Hangar, Mini Storage, Motel, Office Building, Office Class A, Office Class C, Recreational, Restaurant, Storage Warehouse

*Per Pierce County's suggestion, Post-FIRM basements have been converted to crawlspace

FF_ELEVATION

Initial FIRM Date

Community	Initial FIRM Date
Gig Harbor	1981
Steilacoom	1982
Tacoma	1983
Unincorporated Areas	1987
University Place (Using Pierce County date)	1987

If Coastal A Zone

Foundation	Pre-FIRM First Floor Elevation	Post-FIRM Floor Elevation
Pier (2)	5	6
Basement (4)	4	4*
Crawlspace (5)	3	4
Slab (7)	1	1

If V Zone

Foundation	Pre-FIRM First Floor Elevation	Post-FIRM Floor Elevation
Pier (2)	5	6
Basement (4)	4	N/A**
Crawlspace (5)	3	N/A**
Slab (7)	1	N/A**

*Per Pierce County's suggestion, Post-FIRM basements have been converted to crawlspace

**Any Post-FIRM Zone V structure with an attributed basement, crawlspace, or slab has been converted to Pre-FIRM assumptions --- This assumes Zone V was designated after a structure was built

BLDG DAMAGEFNID, CONT DAMAGEFNID, INV DAMAGEFNID

Occupancy	Building Damage Function ID	Content Damage Function ID	Inventory Damage Function ID
AGR1	616	616	116
COM1	217	217	1
COM10	543	357	
COM2	341	195	46
COM3	375	240	
COM4	431	280	
COM5	467	304	
COM6	474	309	
COM7	475	312	
COM8	493	322	
COM9	532	352	
EDU1	643	480	
GOV1	631	472	
GOV2	640	477	
IND1	545	358	70
IND2	559	384	81
IND3	575	408	93
IND4	586	433	106
IND5	591	442	111
IND6	592	443	112

Occupancy	Building Damage Function ID	Content Damage Function ID	Inventory Damage Function ID
REL1	624	467	
RES1	105	21	
RES1 (V Zone, 1 Story)	113	29	
RES1 (V Zone, 2 Story)	115	31	
RES1 (V Zone, 3 Story)	117	33	
RES2	189	74	
RES3A	204	81	
RES3B	204	81	
RES3C	204	81	
RES3D	204	81	
RES3E	204	81	
RES3F	204	81	
RES4	209	85	
RES5	214	88	
RES6	215	89	

*Blue Occupancies and Damage Function IDs were used

Notes: The following codes were used in the UDF database and Hazus earthquake analysis. Pre-code is any building built prior to 1941. Moderate code is any building built post-1941. These values are the Hazus defaults. The dates differ for the building code analysis since additional research was done to understand the building codes in Washington State. An additional Hazus analysis will have to be completed to incorporate updated pre-code for structures built prior to 1975 and moderate code for structures built after 1975, which will result in higher damages for those buildings built between 1941 and 1975.

UDF Input Correction Methodology

The project team performed queries and data fixes on the M7.1 Tacoma Fault Earthquake event in November 2015. The original database ([Tacom UDF 71] renamed to [Tacoma]) had a mismatch in # of records between hzUserDefinedFlty and eqUserDefinedFlty. Because the records in the eqUserDefinedFlty are the controlling ones (they have the hazard data) and are exactly half those in hzUserDefinedFlty (255,871 records vs 511,742), it is a safe assumption that the records were imported twice and need to be deleted. The procedure is shown below:

```
-- Delete duplicated records in hzUserDefinedFlty

SELECT UserDefinedFltyId into #t10 FROM [hzUserDefinedFlty] EXCEPT SELECT UserDefinedFltyId FROM
eqUserDefinedFlty

SELECT * from #t10  -- verify (will have 255,871 records)

DELETE FROM [hzUserDefinedFlty] where UserDefinedFltyId in (select UserDefinedFltyId from #t10)

 -- Even after step above, hzUserDefinedFlty seems to have still duplicate records "datawise"

--  if we consider tract and name as the identifiers, for example, the following query returns 2 records with
same data

select * from hzUserDefinedFlty where tract ='53053060300' and name='3160000090'
```

US490215	US490216
RES1	RES1
53053060300	53053060300
3160000090	3160000090
4821 N BRISTOL ST Tacoma WA	4821 N BRISTOL ST Tacoma WA
NULL	NULL
NULL	NULL
NULL	NULL
1912	1912
84.50	84.50
NULL	NULL
2	2
1176	1176
42.25	42.25
NULL	NULL
47.293986	47.293986
-122.519312	-122.519312
NULL	NULL

```
-- There are 176 records that are duplicates that can be listed with following query
```

```
select tract, name, count(*) as cnt from [Tacoma].[dbo].[hzUserDefinedFlty] group by tract, name having count(*) > 1

-- To delete the duplicate rows, we just pick the ones with max(id) -min(id) will do the same

DELETE

FROM hzUserDefinedFlty

WHERE [UserDefinedFltyId] IN

(SELECT max([UserDefinedFltyId]) FROM hzUserDefinedFlty GROUP BY tract, name having count(*) > 1)

-- QA

select count(*) from hzUserDefinedFlty        -- 255,695 now (used to be 255,871)

-- DONE.

-- PortfolioAnalyzer application expects data in the [Site] table. Move data from hzUserDefinedFlty/eqUserDefinedFlty to it

DELETE FROM [Site]

-- Move main data from eqUserDefinedFlty

insert into [Site] (

        [SiteId],[eqBldgType],[Occupancy],[DesignLevel],[FoundationType],[Latitude],[Longitude],[SoilType],[LqfSusCat],[LndSusCat],

        [WaterDepth],[Distance],[PGA],[PGV],[Sa03],[Sa10],[LqfSettlPGD],[LqfSprPGD],[LqfProb],[LndPGD],[LndProb],[SufFltRuptPGD],[SurfFltRuptProb])

    SELECT    UserDefinedFltyId,[eqBldgType],'RES1',  [DesignLevel],[FoundationType],  100.0,  100.0,[SoilType],[LqfSusCat],[LndSusCat],

        [WaterDepth],[Distance],[PGA],[PGV],[Sa03],[Sa10],[LqfSettlPGD],[LqfSprPGD],[LqfProb],[LndPGD],[LndProb],[SufFltRuptPGD],[SurfFltRuptProb]

    FROM eqUserDefinedFlty

-- Move/updated name, occupancy, latitude, longitude field from hzUserDefinedFlty (via join)

UPDATE [Site] SET Name= h.Name, Occupancy = h.Occupancy, Latitude = h.Latitude, Longitude = h.Longitude, BldgExp = h.Cost, ContentExp = h.ContentCost

    FROM hzUserDefinedFlty h JOIN [Site] s on s.SiteId = h.UserDefinedFltyId

UPDATE [Site] SET OtherStructsExp = 0.0, BIExp = 0.0, EQLimitExp = 0.0, EQDeductValue = 0

-- Via SSMS, import [Site] table form study region into [Portfolio] database. When data, run data ready and PortfolioAnalyzer tool can be run.
```

Essential Facilities and Government Loss Table by Community

JURISDICTION	ESSENTIAL FACILITY	TOTAL FACILITIES*	FACILITIES WITH 5% LOSS RATIO OR HIGHER	PERCENT FACILITIES WITH 5% LOSS RATIO OR HIGHER	TOTAL FACILITIES VALUE	ECONOMIC LOSS	LOSS RATIO
AUBURN	Government (Other)	3	1	33.3%	$25,934,400	$3,031,395	11.7%
	TOTAL	**3**	**1**	**33.0%**	**$25,934,400**	**$3,031,395**	**11.7%**
BONNEY LAKE	Educational	4	2	50.0%	$71,970,300	$3,603,030	5.0%
	Fire	1	0	0.0%	$22,050	$529	2.4%
	Government (Other)	25	7	28.0%	$50,392,200	$2,029,596	4.0%
	TOTAL	**30**	**9**	**30.0%**	**$122,384,550**	**$5,633,155**	**4.6%**
BUCKLEY	Educational	2	2	100.0%	$8,545,500	$440,307	5.2%
	Fire	1	0	0.0%	$1,357,200	$20,672	1.5%
	Government (Other)	15	0	0.0%	$9,532,800	$370,335	3.9%
	Police	1	0	0.0%	$522,900	$20,907	4.0%
	TOTAL	**19**	**2**	**10.5%**	**$19,958,400**	**$852,220**	**4.3%**
CARBONADO	Educational	1	0	0.0%	$1,859,550	$20,086	1.1%
	Fire	1	0	0.0%	$22,800	$155	0.7%
	Government (Other)	2	0	0.0%	$522,900	$8,378	1.6%
	TOTAL	**4**	**0**	**0.0%**	**$2,405,250**	**$28,619**	**1.2%**
DUPONT	Educational	2	0	0.0%	$32,754,900	$667,222	2.0%
	Government (Other)	10	0	0.0%	$12,498,300	$130,904	1.0%
	TOTAL	**12**	**0**	**0.0%**	**$45,253,200**	**$798,126**	**1.8%**
EATONVILLE	Educational	3	0	0.0%	$13,534,500	$44,339	0.3%
	Fire	1	0	0.0%	$131,100	$384	0.3%
	Government (Other)	7	0	0.0%	$1,347,000	$7,047	0.5%
	Police	1	0	0.0%	$131,100	$384	0.3%
	TOTAL	**12**	**0**	**0.0%**	**$15,143,700**	**$52,155**	**0.3%**

JURISDICTION	ESSENTIAL FACILITY	TOTAL FACILITIES*	FACILITIES WITH 5% LOSS RATIO OR HIGHER	PERCENT FACILITIES WITH 5% LOSS RATIO OR HIGHER	TOTAL FACILITIES VALUE	ECONOMIC LOSS	LOSS RATIO
EDGEWOOD	Educational	4	3	75.0%	$21,844,050	$1,587,643	7.3%
	Fire	1	1	100.0%	$1,077,300	$54,071	5.0%
	Government (Other)	11	5	45.5%	$4,120,200	$180,353	4.4%
	Police	1	0	0.0%	$548,850	$20,816	3.8%
	TOTAL	**17**	**9**	**52.9%**	**$27,590,400**	**$1,842,883**	**6.7%**
FIFE	Educational	3	1	33.3%	$41,076,900	$1,877,123	4.6%
	Fire	1	1	100.0%	$610,950	$45,402	7.4%
	Government (Other)	17	6	35.3%	$12,203,700	$619,890	5.1%
	Health Care	2	1	50.0%	$11,648,250	$883,164	7.6%
	Police	1	0	0.0%	$2,492,700	$72,125	2.9%
	TOTAL	**24**	**9**	**52.9%**	**$68,032,500**	**$3,497,704**	**5.1%**
FIRCREST	Educational	1	0	0.0%	$3,771,150	$106,899	2.8%
	Fire	1	1	100.0%	$385,725	$24,611	6.4%
	Government (Other)	5	1	20.0%	$7,682,250	$297,514	3.9%
	Police	1	1	100.0%	$385,725	$24,611	6.4%
	TOTAL	**8**	**3**	**37.5%**	**$12,224,850**	**$453,636**	**3.7%**
GIG HARBOR	Educational	7	7	100.0%	$53,919,700	$11,453,894	21.2%
	Fire	1	1	100.0%	$1,393,950	$95,576	6.9%
	Government (Other)	35	30	85.7%	$73,856,700	$8,540,384	11.6%
	Health Care	3	3	100.0%	$113,109,750	$30,021,231	26.5%
	TOTAL	**46**	**41**	**89.1%**	**$242,280,100**	**$50,111,085**	**20.7%**
LAKEWOOD	Educational	21	0	0.0%	$359,029,850	$10,742,184	3.0%
	Fire	5	0	0.0%	$60,250,450	$1,349,411	2.2%
	Government (Other)	61	0	0.0%	$92,977,650	$2,716,993	2.9%
	Health Care	6	0	0.0%	$107,053,850	$2,142,261	2.0%

JURISDICTION	ESSENTIAL FACILITY	TOTAL FACILITIES*	FACILITIES WITH 5% LOSS RATIO OR HIGHER	PERCENT FACILITIES WITH 5% LOSS RATIO OR HIGHER	TOTAL FACILITIES VALUE	ECONOMIC LOSS	LOSS RATIO
	Police	1	0	0.0%	$9,640,350	$323,621	3.4%
	TOTAL	**94**	**0**	**0.0%**	**$628,952,150**	**$17,274,470**	**2.7%**
MILTON	Educational	3	0	0.0%	$14,457,300	$370,304	2.6%
	Fire	1	0	0.0%	$1,175,850	$101,441	8.6%
	Government (Other)	9	0	0.0%	$16,859,700	$1,812,923	10.8%
	Health Care	1	0	0.0%	$3,890,550	$196,461	5.0%
	Police	1	0	0.0%	$222,750	$21,600	9.7%
	TOTAL	**15**	**0**	**0.0%**	**$36,606,150**	**$2,502,729**	**6.8%**
ORTING	Educational	3	0	0.0%	$31,047,000	$1,183,241	3.8%
	Government (Other)	11	0	0.0%	$20,730,600	$444,842	2.1%
	TOTAL	**14**	**0**	**0.0%**	**$51,777,600**	**$1,628,082**	**3.1%**
PIERCE COUNTY (UNINCORPORATED AREAS)	Educational	87	9	10.3%	$755,294,150	$27,402,863	3.6%
	Fire	53	17	32.1%	$38,274,150	$3,186,324	8.3%
	Government (Other)	304	48	15.8%	$291,181,219	$21,862,840	7.5%
	Health Care	2	0	0.0%	$2,369,400	$19,240	0.8%
	Police	6	1	16.7%	$11,509,425	$530,016	4.6%
	TOTAL	**452**	**75**	**16.6%**	**$1,098,628,344**	**$53,001,284**	**4.8%**
PUYALLUP	Educational	17	5	29.4%	$167,953,200	$7,921,047	4.7%
	Fire	4	2	50.0%	$57,864,300	$1,443,116	2.5%
	Government (Other)	35	17	48.6%	$89,445,750	$4,284,081	4.8%
	Health Care	3	0	0.0%	$274,245,300	$7,281,743	2.7%
	Police	1	1	100.0%	$3,487,350	$207,910	6.0%
	TOTAL	**60**	**25**	**41.7%**	**$592,995,900**	**$21,137,897**	**3.6%**
ROY	Educational	1	0	0.0%	$2,214,900	$9,021	0.4%
	Fire	1	0	0.0%	$344,250	$1,251	0.4%

JURISDICTION	ESSENTIAL FACILITY	TOTAL FACILITIES*	FACILITIES WITH 5% LOSS RATIO OR HIGHER	PERCENT FACILITIES WITH 5% LOSS RATIO OR HIGHER	TOTAL FACILITIES VALUE	ECONOMIC LOSS	LOSS RATIO
	Government (Other)	4	0	0.0%	$1,413,600	$5,924	0.4%
	Police	1	0	0.0%	$430,950	$1,555	0.4%
	TOTAL	**7**	**0**	**0.0%**	**$4,403,700**	**$17,751**	**0.4%**
RUSTON	Government (Other)	1	1	100.0%	$235,050	$15,760	6.7%
	Police	1	1	100.0%	$356,850	$31,000	8.7%
	TOTAL	**2**	**2**	**100.0%**	**$591,900**	**$46,760**	**7.9%**
SOUTH PRAIRIE	Fire	1	1	100.0%	$1,111,500	$48,085	4.3%
	Government (Other)	4	4	100.0%	$179,100	$6,071	3.4%
	TOTAL	**5**	**5**	**100.0%**	**$1,290,600**	**$54,156**	**4.2%**
STEILACOOM	Educational	3	0	0.0%	$28,448,700	$971,792	3.4%
	Government (Other)	8	0	0.0%	$3,025,700	$63,285	2.1%
	Police	1	0	0.0%	$844,800	$11,850	1.4%
	TOTAL	**12**	**0**	**0.0%**	**$32,319,200**	**$1,046,927**	**3.2%**
SUMNER	Educational	3	3	100.0%	$59,373,900	$4,443,539	7.5%
	Fire	1	0	0.0%	$110,550	$4,167	3.8%
	Government (Other)	20	10	50.0%	$22,401,750	$1,300,299	5.8%
	Police	1	1	100.0%	$4,456,800	$335,197	7.5%
	TOTAL	**25**	**14**	**56.0%**	**$86,343,000**	**$6,083,202**	**7.0%**
TACOMA	Educational	75	48	64.0%	$919,995,300	$55,092,388	6.0%
	Fire	13	9	69.2%	$12,694,050	$732,700	5.8%
	Government (Other)	175	93	53.1%	$709,033,300	$36,311,749	5.1%
	Health Care	13	5	38.5%	$304,472,100	$13,725,423	4.5%
	Police	3	2	66.7%	$225,724,500	$23,177,275	10.3%
	TOTAL	**279**	**157**	**56.3%**	**$2,171,919,250**	**$129,039,535**	**5.9%**

JURISDICTION	ESSENTIAL FACILITY	TOTAL FACILITIES*	FACILITIES WITH 5% LOSS RATIO OR HIGHER	PERCENT FACILITIES WITH 5% LOSS RATIO OR HIGHER	TOTAL FACILITIES VALUE	ECONOMIC LOSS	LOSS RATIO
UNIVERSITY PLACE	Educational	10	0	0.0%	$86,897,650	$2,300,924	2.6%
	Fire	1	1	100.0%	$2,310,900	$117,440	5.1%
	Government (Other)	20	8	40.0%	$45,753,900	$1,615,274	3.5%
	Health Care	3	0	0.0%	$5,814,450	$191,986	3.3%
	Police	1	1	100.0%	$2,310,900	$117,440	5.1%
	TOTAL	**35**	**10**	**28.6%**	**$143,087,800**	**$4,343,064**	**3.0%**
WILKESON	Government (Other)	4	0	0.0%	$792,300	$8,236	1.0%
	TOTAL	**4**	**0**	**0.0%**	**$792,300**	**$8,236**	**1.0%**

*where Hazus data were available

Risk Database

Grouping	Component	LAYER Feature Name	DESCRIPTION
Essential Facilities	Health Care	EF_Care	User Defined Facilities residing within Public Health Care Facility Parcels.
	Fire	EF_Fire	User Defined Facilities residing within Fire Facility Parcels.
	Police	EF_Police	User Defined Facilities residing within Police Facility Parcels.
	School	EF_School	User Defined Facilities residing within School Facility Parcels.
	All Essential Facilities	EF_Master	Essential Facilities attributed with earthquake and flood losses (if available) and multi-hazard data and classifications.
Earthquake Hazard	Instrumental Intensity	Haz_Earthquake_Instrumental Intensity	Shaking of the ground due to an earthquake.
	Peak Ground Acceleration	Haz_Earthquake_PeakGroundAcceleration	Highest amount of ground motion at the base of a structure.
	Peak Ground Velocity	Haz_Earthquake_PeakGroundVelocity	Displays pattern of the earthquake faulting geometry.
	Peak Spectral Acceleration 0.3 Second Period	Haz_Earthquake_PeakSpectralAcceleration03	Maximum acceleration experienced by a structure at a 0.3 second period.
	Peak Spectral Acceleration 1.0 Second Period	Haz_Earthquake_PeakSpectralAcceleration10	Maximum acceleration experienced by a structure at a 1 second period.

Grouping	Component	LAYER Feature Name	DESCRIPTION
	Peak Spectral Acceleration 3.0 Second Period	Haz_Earthquake_PeakSpectralAcceleration30	Maximum acceleration experienced by a structure at a 3 second period.
Flood Hazard	Hazard Area	Haz_Flood	Identified SFHAs and other corresponding zones of known or unknown flood risk.
	Coastal Depth Grid	Haz_Flood_CoastalDepthGrid	Flooding depth in feet during a 1%-annual-chance flood event (coastal only).
	Coastal Depth Grid (Plus 1 foot)	Haz_Flood_CoastalDepthGrid_Plus1Ft	Flood inundation during a 1%-annual-chance flood and at 1 foot increments from the 1%-annual-chance base flood elevation (coastal only).
	Coastal Depth Grid (Plus 2 feet)	Haz_Flood_CoastalDepthGrid_Plus2Ft	
	Coastal Depth Grid (Plus 3 feet)	Haz_Flood_CoastalDepthGrid_Plus3Ft	
Landslide Hazard	Hazard Area	Haz_Landslide	Landslide hazard area.
Liquefaction Hazard	Hazard Area	Haz_Liquefaction	Liquefaction hazard area.
Tsunami Hazard	Hazard Area	Haz_Tsunami	Tsunami hazard area.
	Depth Grid	Haz_Tsunami_DepthGrid	Tsunami depth in meters during an M7.1 Tacoma Fault Earthquake.
Volcanic Hazard	Hazard Area	Haz_Volcanic	Lahar and Pyroclastic Flow hazard area.
Political Boundaries	Jurisdictional Boundaries	Pol_Boundaries	Political Boundaries taken from effective or preliminary flood studies.
UDF	Raw Data	UDF_Input	User Designed Facilities are attributed with basic information including cost, contents cost, design quality, area, building type, year built, location, etc. For certain hazards (earthquake and flood), loss estimates and the loss ratio are provided. For other hazards, a simple intersect between the hazard layer and UDF point was used.
UDF Hazard Analysis	Earthquake	UDF_Earthquake	
	Flood	UDF_Flood	
	Landslide	UDF_Landslide	
	Liquefaction	UDF_Liquefaction	
	Tsunami	UDF_Tsunami	
	Volcanic	UDF_Volcanic	

Acronyms and Definitions

AOMI Area of Mitigation Interest

BFE Base Flood Elevation

CCO Consultation Coordination Officer

EF Essential Facility

FIRM Flood Insurance Rate Map

FRR Flood Risk Review GBS General Building Stock

IBC International Building Code

NOAA National Oceanic and Atmospheric Administration

Risk MAP Risk Mapping, Assessment, and Planning Program

SFHA Special Flood Hazard Area

UBC Uniform Building Code

UDF User Defined Facility

USGS U.S. Geological Survey

WADNR Washington State Department of Natural Resources

Additional Resources

Hazus-MH Earthquake Model

Technical Manual:
http://www.fema.gov/media-library-data/20130726-1820-250456286/hzmh2_1_eq_tm.pdf

User Manual:
http://www.fema.gov/media-library-data/20130726-1820-250451179/hzmhs2_1_eq_um.pdf

Hazus-MH Flood Model

Technical Manual:
http://www.fema.gov/media-library-data/20130726-1820-250458292/hzmh2_1_fl_tm.pdf

User Manual:
http://www.fema.gov/media-library-data/20130726-1820-250458814/hzmh2_1_fl_um.pdf

Other

USGS ShakeMap Scenarios:
http://earthquake.usgs.gov/earthquakes/shakemap/global/shake/Casc9.0_expanded_se/

WA Geological Information Portal:
https://fortress.wa.gov/dnr/geology/
http://www.dnr.wa.gov/ResearchScience/Topics/GeosciencesData/Pages/geology_portal.aspx