South Whidbey School District

HAZARD MITIGATION PLAN

2016

South Whidbey School District
5520 Maxwelton Rd
Langley, Washington 98260

The 2016 South Whidbey School District’s Hazard Mitigation Plan is a living document which will be reviewed and updated periodically.

Comments, suggestions, corrections, and additions are enthusiastically encouraged from all interested parties.

Please send comments and suggestions to:

Brian Miller
Director of Facilities and Operations
5520 Maxwelton Rd
Langley, WA 98260

bmiller@sw.wednet.edu

EXECUTIVE SUMMARY

The South Whidbey School District Hazard Mitigation Plan covers each of the major natural hazards that pose significant threats to the District.

The mission statement of the South Whidbey School District Hazard Mitigation Plan is to:

> Proactively facilitate and support district-wide policies, practices, and programs that make the South Whidbey School District more disaster resistant and disaster resilient.

Making the South Whidbey School District more disaster resistant and disaster resilient means taking proactive steps and actions to protect life safety, reduce property damage, minimize economic losses and disruption, and shorten the recovery period from future disasters. This plan is an educational and planning document that is intended to raise awareness and understanding of the potential impacts of natural hazard disasters and to help the District deal with natural hazards in a pragmatic and cost-effective manner.

Mitigation simply means actions that reduce the potential for negative consequences from future disasters. Such actions reduce future damages, losses, and casualties. Effective mitigation planning will help the South Whidbey School District deal with natural hazards realistically and rationally by identifying where the level of risk from one or more hazards may be unacceptably high and finding cost effective ways to reduce such risk. Mitigation planning strikes a pragmatic middle ground between unwisely ignoring the potential for major hazard events on one hand and unnecessarily overreacting to the potential for disasters on the other hand.

Completely eliminating the risk of future disasters in the South Whidbey School District is neither technologically possible nor economically feasible. However, substantially reducing the negative consequences of future disasters is achievable with the implementation of a pragmatic Hazard Mitigation Plan.

This mitigation plan focuses on the hazards that pose the greatest threats to the District's facilities and people: Earthquakes and Wildfire. Other natural hazards that pose lesser threats are addressed briefly.

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1.0 INTRODUCTION

1.1 What is a Hazard Mitigation Plan?

The South Whidbey School District Hazard Mitigation Plan covers each of the major natural hazards that pose significant threats to the District.

The effects of potential future disaster events on the South Whidbey School District may be minor - a few inches of water in a street - or may be major - with widespread damages, deaths and injuries, and economic losses reaching millions of dollars. The effects of major disasters on a district and on the communities served by a district can be devastating: the total damages, economic losses, casualties, disruption, hardships, and suffering are often far greater than the physical damages alone.

The mission statement of the South Whidbey School District Hazard Mitigation Plan is to:

> Proactively facilitate and support district-wide policies, practices, and programs that make the South Whidbey School District more disaster resistant and disaster resilient.

Making the South Whidbey School District more disaster resistant and disaster resilient means taking proactive steps and actions to protect life safety, reduce property damage, minimize economic losses and disruption, and shorten the recovery period from future disasters.

This plan is an educational and planning document that is intended to raise awareness and understanding of the potential impacts of natural hazard disasters and to help the District deal with natural hazards in a pragmatic and cost-effective manner. It is important to recognize that the Hazard Mitigation Plan is not a regulatory document and does not change existing District policies or zoning, building codes, or other ordinances that apply to the District.

Completely eliminating the risk of future disasters in the South Whidbey School District is neither technologically possible nor economically feasible. However, substantially reducing the negative consequences of future disasters <u>is</u> achievable with the implementation of a pragmatic Hazard Mitigation Plan.

Mitigation simply means actions that reduce the potential for negative consequences from future disasters. That is, mitigation actions reduce future damages, losses, and casualties.

The South Whidbey School District mitigation plan has several key elements:

1. Each hazard that may significantly affect the South Whidbey School District's facilities is reviewed to estimate the probability (frequency) and severity of likely hazard events.

2. The vulnerability of South Whidbey School District to each hazard is evaluated to determine the likely severity of physical damages, casualties, and economic consequences.

3. A range of mitigation actions are evaluated to identify those with the greatest potential to reduce future damages and losses to the South Whidbey School District and that are desirable from the community's political and economic perspectives.

1.2 Why is Mitigation Planning Important for the South Whidbey School District?

Effective mitigation planning will help the South Whidbey School District deal with natural hazards realistically and rationally. That is, to identify where the level of risk from one or more hazards may be unacceptably high and then to find cost effective ways to reduce such risk. Mitigation planning strikes a pragmatic middle ground between unwisely ignoring the potential for major hazard events on one hand and unnecessarily overreacting to the potential for disasters on the other hand.

Furthermore, the Federal Emergency Management Agency (FEMA) now requires each local government entity to adopt a multi-hazard mitigation plan to remain eligible for future pre- or post-disaster FEMA mitigation funding. Thus, an important objective in developing this plan is to maintain eligibility for FEMA funding and to enhance the South Whidbey School District's ability to attract future FEMA mitigation funding.

Further information about FEMA mitigation grant programs is given in Appendix 1: FEMA Mitigation Grant Programs.

1.3 The South Whidbey School District Hazard Mitigation Plan

This South Whidbey School District Hazard Mitigation Plan is built upon a quantitative assessment of each of the major hazards that may significantly affect the South Whidbey School District, including their frequency, severity, and the campuses most likely to be affected. This assessment draws heavily on statewide data collected for the development of the Washington State K–12 Facilities Hazard Mitigation Plan and on additional district-specific data.

These reviews of the hazards and the vulnerability of South Whidbey School District to these hazards are the foundation of the District's mitigation plan. From these assessments, the greatest threats to the District's facilities are identified. These high risk situations then become priorities for future mitigation actions to reduce the negative consequences of future disasters affecting the South Whidbey School District.

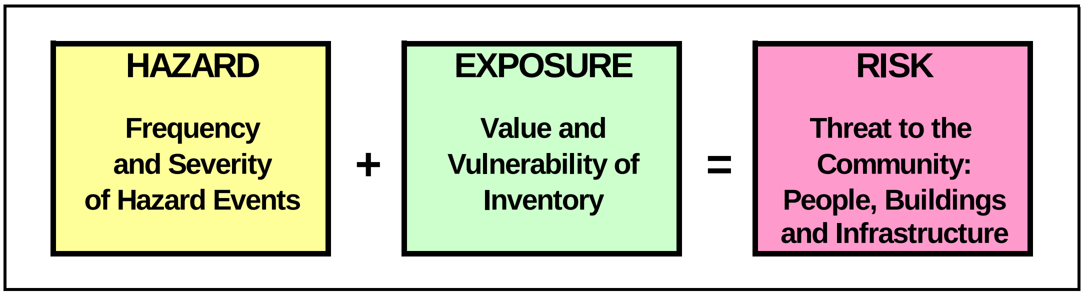
The South Whidbey School District Hazard Mitigation Plan deals with hazards realistically and rationally and also strikes a balance between suggested physical mitigation actions to eliminate or reduce the negative consequences of future disasters and planning measures which better prepare the community to respond to, and recover from, disasters for which physical mitigation actions are not possible or not economically feasible.

1.4 Key Concepts and Definitions

The central concept of mitigation planning is that mitigation reduces risk. **Risk** is defined as the threat to people and the built environment posed by the hazards being considered. That is, risk is the potential for damages, losses, and casualties arising from the impact of hazards on the built environment. The essence of mitigation planning is to identify facilities in the South Whidbey School District that are at high risk from one or more natural hazards and to evaluate ways to mitigate (reduce) the effects of future disasters on these high risk facilities.

The level of risk at a given location, building, or facility depends on the combination of **hazard** frequency and severity plus the **exposure,** as shown in Figure 1 below.

Figure 1.1
Hazard and Exposure Combine to Produce Risk



Risk is generally expressed in dollars (estimates of potential damages and other economic losses) and in terms of casualties (numbers of deaths and injuries).

There are four key concepts that govern hazard mitigation planning: hazard, exposure, risk, and mitigation. Each of these key concepts is addressed in turn.

HAZARD refers to natural events that may cause damages, losses or casualties, such as earthquakes, tsunamis, and floods. Hazards are characterized by their frequency and severity and by the geographic area affected. Each hazard is characterized differently, with appropriate parameters for the specific hazard. For example, earthquakes are characterized by the probable severity and duration of ground motions while tsunamis are characterized by the areas inundated and by the depth and velocity of the tsunami inundations.

A hazard event, by itself, may not result in any negative effects on a community. For example, a flood-prone five-acre parcel may typically experience several shallow floods per year, with several feet of water expected in a 50-year flood event. However, if the parcel is wetlands, with no structures or infrastructure, then there is no risk. That is, there is no threat to people or the built environment and the frequent flooding of this parcel does not have any negative effects on the community. Indeed, in this case, the very frequent flooding (the high hazard) may be beneficial environmentally by providing wildlife habitat, recreational opportunities, and so on.

The important point is that hazards do not necessarily produce risk to people and property unless there is vulnerable inventory exposed to the hazard. Risk to people, buildings, or infrastructure results only when hazards are combined with an exposure to the hazard.

EXPOSURE is the quantity, value, and vulnerability of the built environment (inventory of people, buildings, and infrastructure) in a particular location subject to one or more hazards. Inventory is described by the number, size, type, use, and occupancy of buildings and by the infrastructure present. Infrastructure includes roads and other transportation systems, utilities (potable water, wastewater, natural gas, and electric power), telecommunications systems, and so on.

For the South Whidbey School District, the built-environment inventory of concern is largely limited to the District's facilities. For planning purposes, schools are often considered critical facilities because they may be used as emergency shelters for the community after disasters and because communities often place a very high priority on providing life safety for children in schools.

For hazard mitigation planning, inventory must be characterized not only by the quantity and value of buildings or infrastructure present, but also by its vulnerability to each hazard under evaluation. For example, a given facility may or may not be particularly vulnerable to flood damages or earthquake damages, depending on the details of its design and construction. Depending on the hazard, different engineering measures of the vulnerability of buildings and infrastructure are used.

RISK is the threat to people and the built environment - the potential for damages, losses, and casualties arising from hazards. Risk results only from the combination of Hazard and Exposure as discussed above and as illustrated schematically in Figure 1.4 on the following page.

Risk is the potential for future damages, losses, or casualties. A disaster event happens when a hazard event is combined with vulnerable inventory (that is when a hazard event strikes vulnerable inventory exposed to the hazard). The highest risk in a community occurs in high hazard areas (frequent and/or severe hazard events) with large inventories of vulnerable buildings or infrastructure.

However, high risk can also occur with only moderately high hazard if there is a large inventory of highly vulnerable inventory exposed to the hazard. Conversely, a high hazard area can have relatively low risk if the inventory is resistant to damages (such as strengthened to minimize earthquake damages).

MITIGATION means actions to reduce the risk due to hazards. Mitigation actions reduce the potential for damages, losses, and casualties in future disaster events. Repair of buildings or infrastructure damaged in a disaster is not mitigation. Hazard mitigation projects may be initiated proactively - before a disaster, or after a disaster has already occurred. In either case, the objective of mitigation is always to reduce future damages, losses, or casualties.

A few common types of mitigation projects are shown in Table 1.1 on the following page.

Table 1.1
Examples of Mitigation Projects

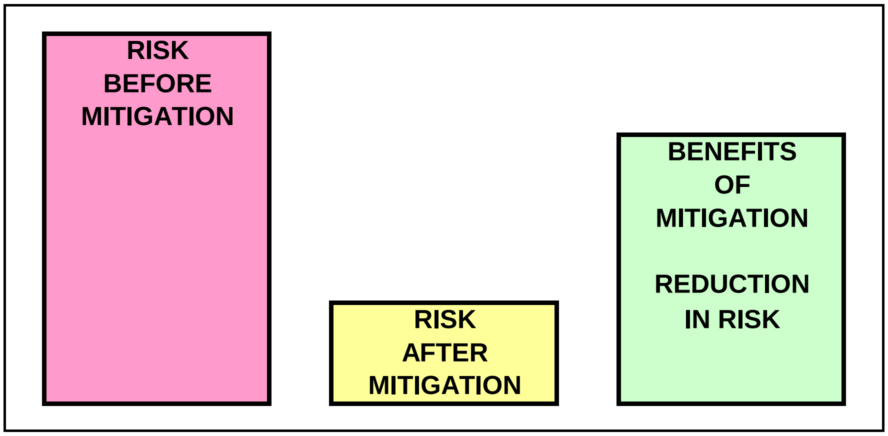
Hazard	Common Mitigation Projects
Earthquake	Structural retrofits for buildings
	Nonstructural retrofits for building elements and contents
	Replace existing building with new, current-code building
Tsunami	Enhance evacuation planning, including practice drills
	Build structure for vertical evacuation
Volcanic Hazards	Enhance evacuation planning, including practice drills
Floods	Flood barriers and other flood proofing measures
	Elevate at risk buildings
Wildland/Urban Interface Fires	Enhance defensible space around buildings
	Fuel reduction measures near campus
	Improve fire resistance of existing buildings
Landslides	Stabilize slopes with improved drainage and/or retaining walls.

The mitigation project list above is not comprehensive; mitigation projects can encompass many other actions to reduce future damages, losses, and casualties.

1.5 The Mitigation Process

The key element for all hazard mitigation projects is that they reduce risk. The benefits of a mitigation project are the reductions in risk (i.e., the avoided damages, losses, and casualties attributable to the mitigation project). Benefits are the difference in expected damages, losses, and casualties before mitigation (as-is conditions) and after mitigation. These important concepts are illustrated on the following page.

Figure 1.5
Mitigation Projects Reduce Risk



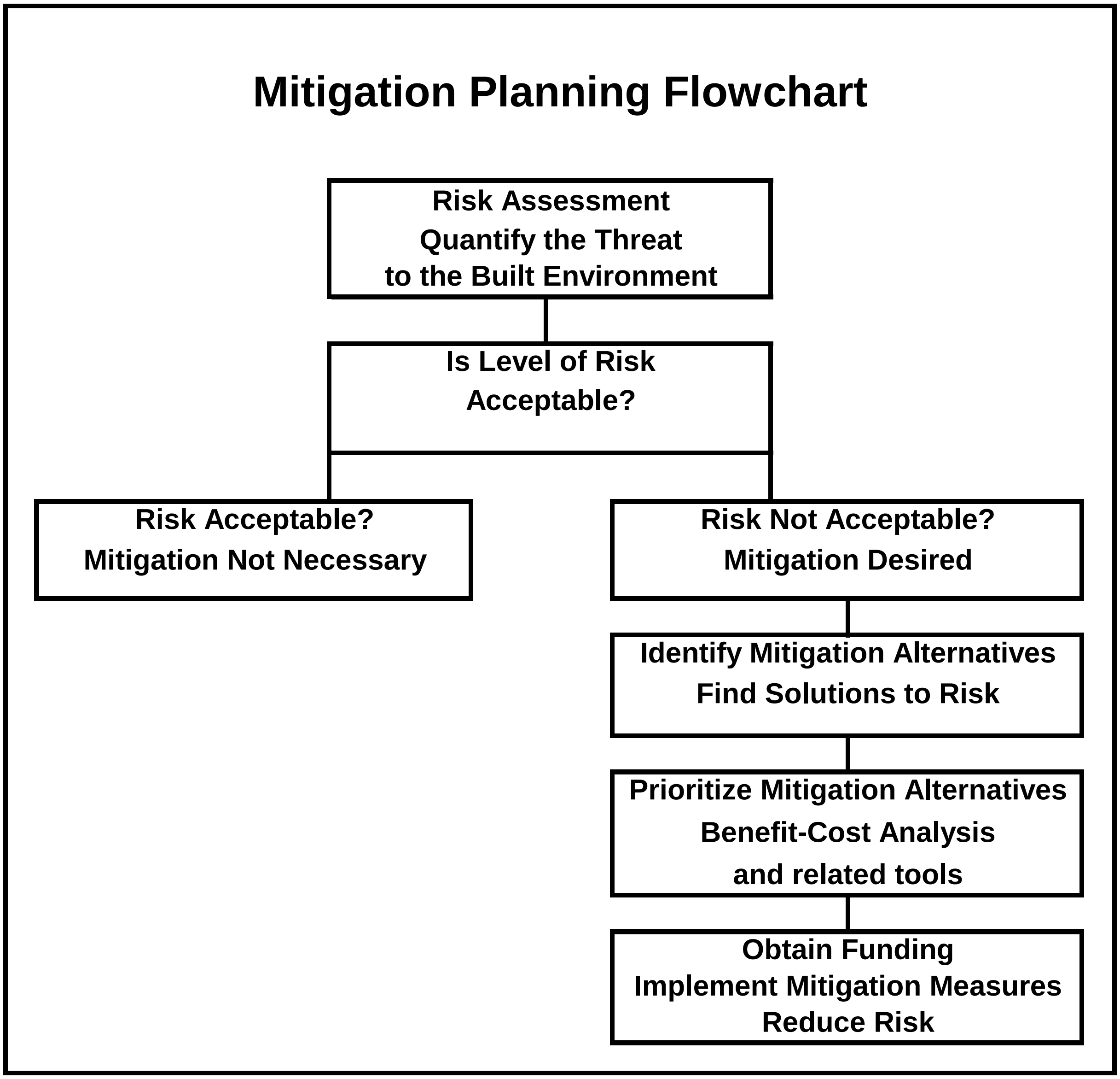
Quantifying the benefits of a proposed mitigation project is an essential step in hazard mitigation planning and implementation. Only by quantifying benefits is it possible to compare the benefits and costs of mitigation to determine whether or not a particular project is worth doing (i.e., whether it is economically feasible). Real world mitigation planning almost always involves choosing between a range of possible alternatives, often with varying costs, and varying effectiveness in reducing risk.

Quantitative risk assessment is centrally important to hazard mitigation planning. When the level of risk is high, the expected levels of damages and losses are likely to be unacceptable to the community and mitigation actions have a high priority: the greater the risk, the greater the urgency of undertaking mitigation.

Conversely, when risk is moderate both the urgency and the benefits of undertaking mitigation are reduced. It is neither technologically possible nor economically feasible to eliminate risk completely. Therefore, when levels of risk are low and/or the cost of mitigation is high relative to the level of risk, the risk may be deemed acceptable (or at least tolerable). Therefore, proposed mitigation projects that address low levels of risk or where the cost of the mitigation project is large relative to the level of risk are generally poor candidates for implementation.

The overall mitigation planning process is outlined in Figure 1.6 on the following page, which shows the major steps in hazard mitigation planning and implementation for the South Whidbey School District.

Figure 1.6
The Mitigation Planning Process



The first steps are quantitative evaluation of the hazards (frequency and severity) affecting the South Whidbey School District and of the inventory (people and facilities) exposed to these hazards. Together, these hazard and exposure data determine the level of risk for specific locations, buildings, or facilities in the South Whidbey School District.

The next key step is to determine whether or not the level of risk posed by each of the hazards affecting the South Whidbey School District is acceptable or tolerable. If the level of risk is deemed acceptable or at least tolerable, then mitigation actions are not necessary or at least not a high priority. There is no absolute universal definition of the level of risk that is tolerable or not tolerable. Each district has to make its own determination.

If the level of risk is deemed not acceptable or tolerable, then mitigation actions are desired. In this case, the mitigation planning process moves on to more detailed evaluation of specific mitigation alternatives, prioritization, funding, and implementation of mitigation actions. As with the determination of whether or not the level of risk posed by each hazard is acceptable or not, decisions about which mitigation projects should be undertaken can only be made by the South Whidbey School District.

1.6 The Role of Benefit-Cost Analysis in Mitigation Planning

Communities, such as the South Whidbey School District, that are considering whether or not to undertake mitigation projects must answer questions that don't always have obvious answers, such as:

What is the nature of the hazard problem?

How frequent and how severe are hazard events?

Do we want to undertake mitigation actions?

What mitigation actions are feasible, appropriate, and affordable?

How do we prioritize between competing mitigation projects?

Are our mitigation projects likely to be eligible for FEMA funding?

Benefit-cost analysis (BCA) is a powerful tool that can help communities provide solid, defensible answers to these difficult socio-political-economic-engineering questions. Benefit-cost analysis is required for all FEMA-funded mitigation projects, under both pre-disaster and post-disaster mitigation programs. However, regardless whether or not FEMA funding is involved, benefit-cost analysis provides a sound basis for evaluating and prioritizing possible mitigation projects for any natural hazard.

Further details about benefit-cost analysis are given in the Appendix 2: Principles of Benefit-Cost Analysis.

1.7 Hazard Synopsis

The following figure illustrates the relative level of hazard for the six major hazards at each of the District's campuses. These hazard levels are based on statewide GIS data and additional district-specific data entered into OSPI's ICOS PDM database.

Figure 1.7
South Whidbey School District: Major Hazards Matrix

South Whidbey	Earthquake	Tsunami	Volcanic	Flood	WUI	Landslide
Admin/Maintenance/Transportation	Very High	None**	None**	None**	None**	None**
Bayview Alternative School	Very High	None**	None**	Low	Moderate	None**
Langley Middle School	Very High	None**	None**	Low	Moderate	None**
South Whidbey Academy	Very High	None**	None**	None**	Low	None**
South Whidbey Elementary School	Very High	None**	None**	None**	Moderate	None**
South Whidbey High School	Very High	None**	None**	None**	Moderate	None**

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[1]**"None" means that the risk to facilities and people is nil or minima.

South Whidbey School District lies in a major earthquake hazard zone, making earthquakes our most significant disaster risk. This risk applies to all structures in the district, but age and construction methods put some facilities at higher risk. This plan covers earthquake hazards and mitigation in detail in chapter 6.

The South Whidbey District is not subject to tsunamis because the district's facilities are located inland from coastal beaches, and the one campus closest to the beach, Langley Middle School, is at an elevation of over one hundred feet. No action items are planned for this hazard.

The South Whidbey District is not subject to volcanic hazards, except possibly for minor volcanic ash falls, because none of the campuses are in, or near, any of the mapped volcanic hazard zones for any of the active volcanoes in Washington State. No action items are planned for this hazard.

Flood risk exists at a low level at two sites, Bayview School and Langley Middle School both reside within 0.5 miles of a FEMA flood zone. Both sites are at good elevations and have no flood events recorded in the past 20 years. Apart from storm water management, no action items are planned for this hazard.

Wildland fire risks are moderate at several of our sites and are covered in detail in chapter 6. South Whidbey School District facilities are not subject to landslides. No action items are planned for this hazard.

Further details regarding these hazards and the level of risk to District facilities and people are presented in subsequent chapters:

Chapter 6: Earthquake

Chapter 7: Wildland/Urban Interface Fires

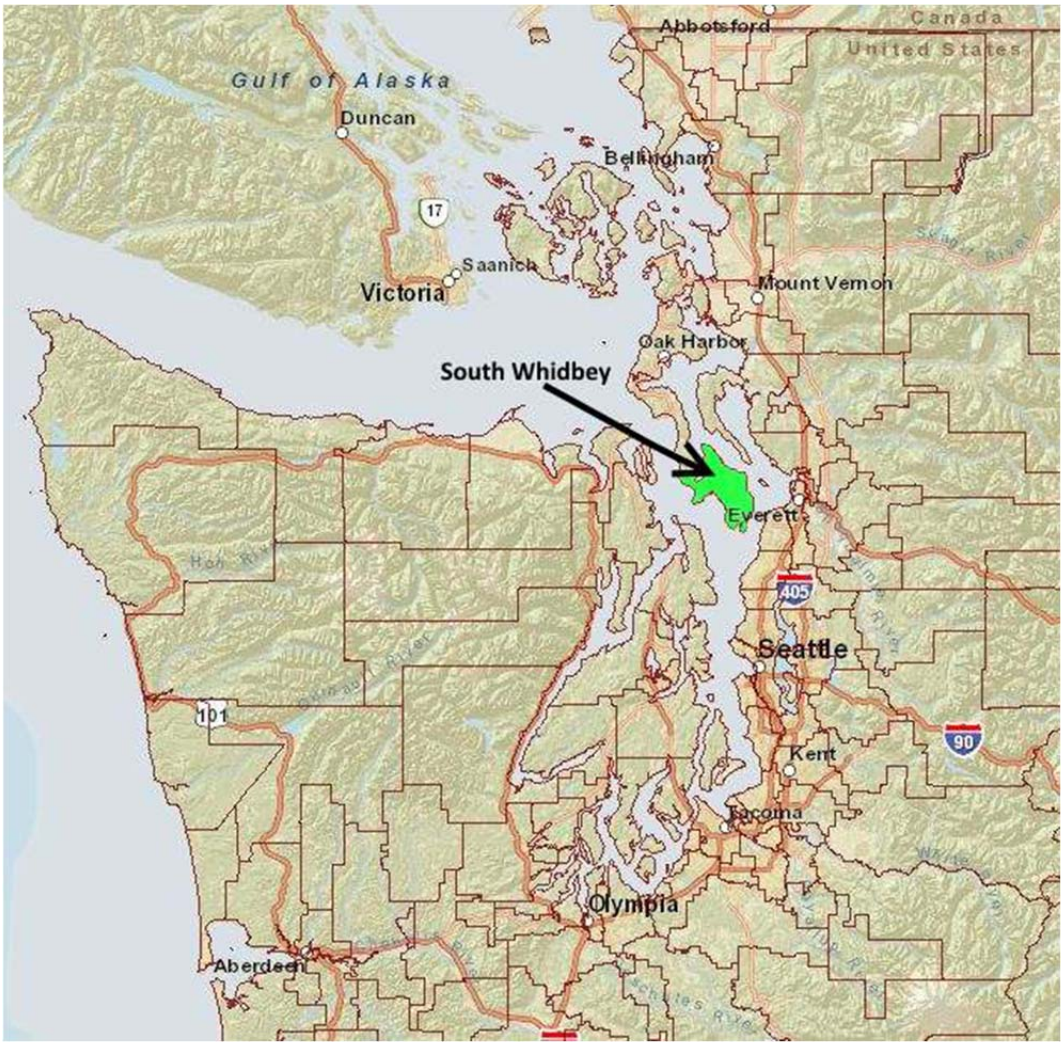
Chapter 8: Other Hazards

2.0 SOUTH WHIDBEY SCHOOL DISTRICT PROFILE

2.1 District Location

The South Whidbey School District is located in Island County in the northern Puget Sound region of Washington State. It is the southernmost of the three school districts on Whidbey Island (see figure 2.1 below).

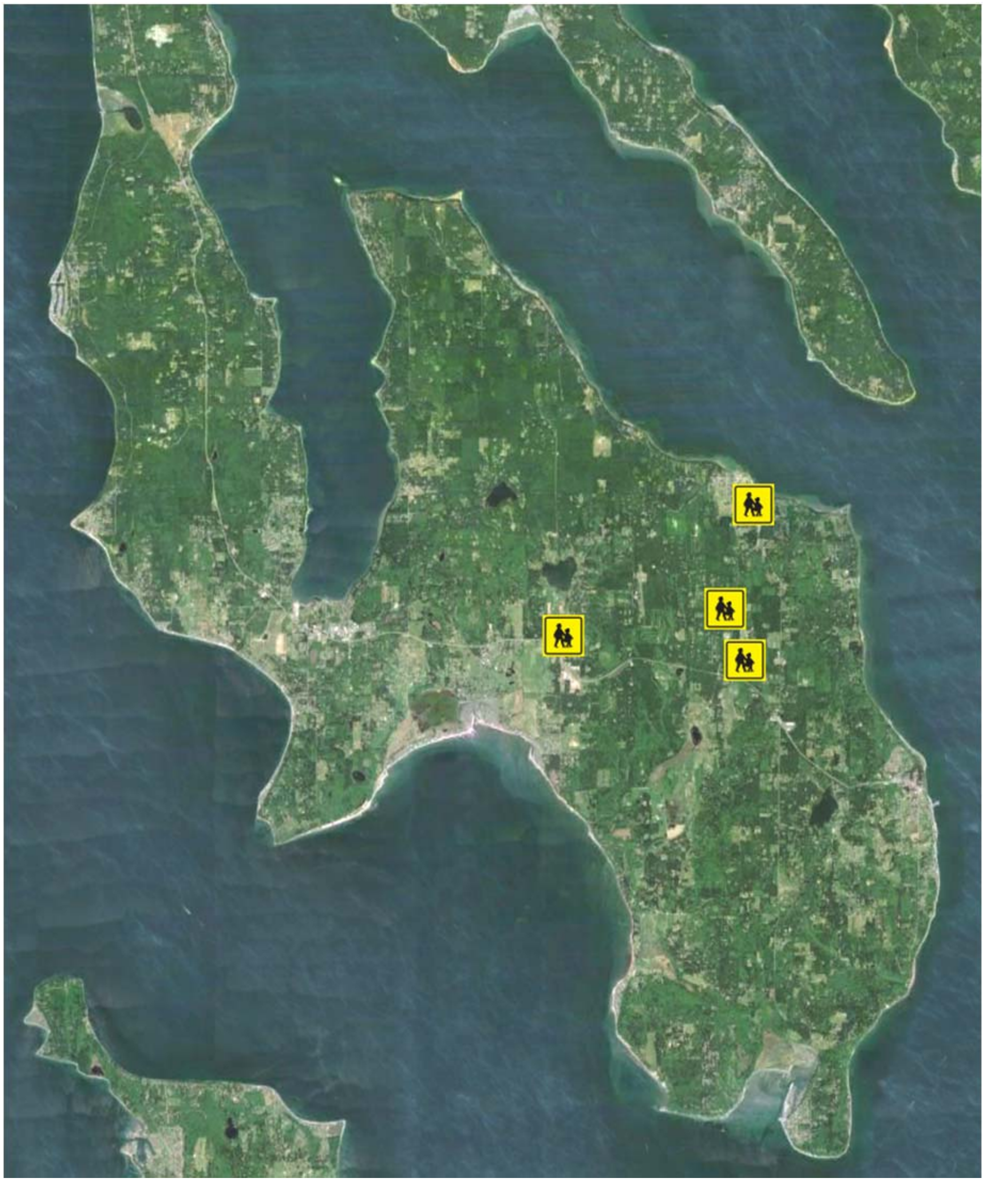
Figure 2.1
South Whidbey School District Map



The South Whidbey School District includes the cities of Clinton, Langley and Freeland, and several unincorporated communities. The total population within the district's boundaries is approximately 15,336 (2010 census).

As shown in the Google Earth image below, the population within the South Whidbey School District is widely dispersed and most of the school facilities are located some distance from the shoreline.

Figure 2.2
South Whidbey School District and Vicinity



2.2: District Overview

The South Whidbey School District is 60 square miles in size and serves approximately 1,362 students in three traditional schools and one alternative program. The district employs approximately 170 FTE and 198 (head count) staff.

The South Whidbey School District's mission statement is:

> *In partnership with our community, we are deeply committed to provide our students with the best educational experience, preparing them to become capable, creative, caring, and responsible citizens.*

Table 2.1: Enrollment (*rounded from October 2014)*

Grade	High	Middle	Elementary	SW Academy	Totals
K			37	2	39
1			66	4	70
2			91	5	96
3			96	4	100
4			102	4	106
5			95	10	105
6		90	1	9	100
7		101	0	10	111
8		105	0	8	113
9	119	0	0	9	128
10	123	0	0	7	130
11	119	0	0	15	134
12	116	0	0	14	130
Total	477	296	488	101	**1362**

Student enrollment by grade and school are provided above in Table 2.1. In addition to our traditional K–12 programs, our facilities also support ECEAP, pre-school and day care facilities. Other community-based programs which user our facilities include: Whidbey Island Nourishes, a volunteer-based non-profit organization providing ready-to-eat meals to those in need; Family Resource Center, a partnership between Readiness to Learn and South Whidbey School District providing programs and resources for children and families; South Whidbey Parks and Recreation, providing sports and organized activities for South Whidbey residents. Our facilities also house Whidbey Children’s Theater and Whidbey Island Dance Theatre, both community-based non-profit organizations.

Demographic data is often included in mitigation plans, especially in the context of evacuation planning and for communication, education, and outreach efforts. The data shown below are for Island County (2010 census), because census data are not compiled for the district’s specific boundaries. These data are approximately representative of those for the South Whidbey School District.

Table 2.2
Selected Demographic Data - Island County

Population	Number	Percent
Total Population	**78,506**	**100.0%**
Under 5 years	4,542	5.8%
5 to 19 years	13,471	17.1%
20 to 39 years	18,354	23.4%
40 to 64 years	27,700	35.3%
65 and over	14,439	18.4%
Median age	**43.2**	**-**
Male population	**38,857**	**49.5%**
Female population	**39,649**	**50.5%**
Race		
White	74,996	95.5%
Black or African American	1,716	2.2%
Hispanic / Latino	4,295	5.5%
American Indian / AK Native	658	0.8%
Asian	3,440	4.4%
Native Hawaiian / Pac Islander	390	0.5%
Other	1,181	1.5%
SWSD Population	**15,336**	**100%**
White	14,437	94.1%
Asian	224	1.5%
Am Indian / AK Native	100	0.7%
Black	71	0.5%
Hawaiian/ Pac Islander	28	0.2%
Other race	75	0.5%
Two or more races	401	2.6%
Hispanic origin	398	2.6%

Additional information about South Whidbey School District may be found at the following link:

http://www.sw.wednet.edu School district web site

Following is a list of additional online resources with demographic information to assist your planning effort:

Washington State Office of Financial Management (links to various data sources):
http://www.ofm.wa.gov/localdata/default.asp

US Census (county specific data): http://quickfacts.census.gov/qfd/states/53/53031.html

Washington State Report Card (school district specific data):
http://reportcard.ospi.k12.wa.us/Summary.aspx?year=2012-13

2.3 District Facilities

The South Whidbey School District has 5 campuses and several other facilities including a transportation/maintenance/district office building and outdoor classroom facility. These facilities are described in Table 2.3 on the following pages.

Table 2.3
District Facilities

District Pre-Disaster Mitigation Summary						
Campus / Building	**Building Condition Rating**	**Number of Floors**	**Building Area**	**Year Built**	**Gross Square Feet**	**Structural System**
SOUTH WHIDBEY SCHOOL DISTRICT						
Admin/Maintenance/Transportation						
Bus Wash	Ratings Not Started	1	Bus Wash	2000	1,672	S3
Fueling Station	Ratings Not Started	1	Fueling Station	2000	3,096	S2L
Main Building	Ratings Not Started	1	Admin	2000	16,000	S2L
Bayview Alternative School						
Main Building	34.97% Poor	2	Bayview	1895	5,186	W1
Langley Middle School						
A - Main Building	44.59% Poor	1	A Classroom	1941	31,818	W1
B - Library Building	44.13% Poor	2	B - Library	1935	9,732	W1
C - Auditorium Building	51.91% Poor	1	C - Auditorium	1960	10,050	W1
D - Spencer Building	53.35% Poor	1	D - Spencer	1954	7,411	W1
E - Gymnasium/Cafeteria	44.77% Poor	2	E - Gynasium/Cafeter	1949	19,139	C2L
F - Cooler building	45.95% Poor	1	Cooler Building	1962	6,181	RM1L
G - Gymnasium Addition	82.10% Fair	1	G - Gym Addition	1995	4,800	RM1L
Greenhouse Building	62.00% Fair	1	Greenhouse	1989	660	
H - Spencer Building Addition	76.96% Fair	1	Spencer Addition	1995	2,790	W1
Old Aministration Building	Ratings Not Started	1	Old Admin Bldg	1985	4,608	W1
Storage Building	Ratings Not Started	1	Storage	1980	5,964	S2L

Table 2.3 (continued)
District Facilities

District Pre-Disaster Mitigation Summary						
Campus / Building	Building Condition Rating	Number of Floors	Building Area	Year Built	Gross Square Feet	Structural System
South Whidbey Academy						
A- Classrooms	54.85% Poor	1				
			A - Classroom	1969	7,253	S5L
B - Playshed	57.63% Poor	1				
			B - Playshed	1969	3,950	S5L
C - Classrooms/Admin	54.53% Poor	1				
			C - Classrooms/Admin	1969	7,253	S5L
D - WIA Office/Classrooms	53.30% Poor	1				
			WIA	1969	8,827	S5L
E - Classrooms	54.75% Poor	1				
			E - Classrooms	1969	4,880	S5L
F - Multipurpose	59.46% Poor	1				
			F - Multipurpose	1969	6,722	S5L
			Stage Addition	1996	972	RM1L
G - Library/Board Room	86.10% Good	1				
			Library/Board Room	1996	4,548	
Portable P-1	Ratings Not Started	1				
			Portable P-1	1989	1,410	
Portable P-2	Ratings Not Started	1				
			Protable P-2	1989	1,024	
Preschool portable	Ratings Not Started	1				
			Preschool	1989	1,694	
South Whidbey Elementary School						
Headstart Portable	Ratings Not Started	1				
			Headstart Portable	2000	2,016	W1
Main Building	68.43% Fair	1				
			South Whidbey Elemen	1988	49,577	W2
North Covered Play	Ratings Not Started	1				
Preschool Portable	Ratings Not Started	1				
			Preschool Portable	2000	1,792	W1
South Covered Play	Ratings Not Started	1				
South Whidbey High School						
1997 Addition	69.29% Fair	2				
			Classroom	1997	65,020	S2L
Concession Stand	Ratings Not Started	1				
			Concessions	1988	1,008	W1
Main Building	52.37% Poor	2				
			Main Building	1989	49,577	S2L
Portables	Ratings Not Started	1				
			Portable 1	2000	1,792	W1
			Portable 2	2000	1,792	W1
			Portable 3	2000	1,792	W1
Stadium Grandstand	Ratings Not Started	1				
			Grandstands	1989	4,066	S3
Storage Sheds	Ratings Not Started	1				
			Storage	1989	2,880	S3

3.0 MITIGATION PLANNING PROCESS

3.1 Overview

The South Whidbey School District's mitigation planning process began in December 2014 of the 2014-15 school year. The District's mitigation plan is consistent with, and draws extensively from, the Washington State K–12 Facilities Hazard Mitigation Plan. However, the South Whidbey School District's Hazard Mitigation Plan has an in-depth focus on the District, its facilities, and its people and includes more district-specific content, including district-specific hazard and risk assessments and mitigation priorities.

3.2 Mitigation Planning Team

The mitigation planning team was led by: Brian Miller, Director of Facilities and Operations. The planning team included the following members:

Brian Miller	Facilities Director, SWSD
Josephine Mocca	Superintendent, SWSD
Dan Poolman	Assist. Superintendent for Business, SWSD
Greg Ballog	Teacher, SWSD
Damian Greene	Board Member, SWSD
Jack Husband	Community Member
John Riley	Community Member

The mitigation planning team's roles and responsibilities were defined as follows:

- Participate actively in planning team meetings,
- Provide local perspectives re: natural hazards and the threats they pose to the District's facilities and people.
- Help to identify existing plans, studies, reports, and technical information for inclusion or reference in the mitigation plan.
- Forge consensus on mitigation action items and their priorities.
- Help to facilitate the public outreach actions during the mitigation planning process, and
- Provide review comments on draft materials during development of the South Whidbey School District Hazard Mitigation Plan.

3.3 Mitigation Planning Team Meetings

Mitigation planning team meetings are documented below with dates and brief summaries.

1st Meeting: December 3, 2014. Mitigation Planning Kick-Off Meeting.

Robert Dengel of OSPI was present to provide an overview of the process, explain the templates developed by OSPI and answer question of committee members.

2nd Meeting: December 17, 2014. Committee reviewed template drafts and discussed possible mitigation actions.

3rd Meeting: January 21, 2015. Reviewed and finalized public survey draft. Discussed mitigation actions.

4th Meeting: February 11, 2015. Finalize actions. Review survey process. Present to board and public.

5th Meeting: May 25, 2016. Present updated plan to board and community for comment.

3.4 Public Involvement in the Mitigation Planning Process

The District involved the public and stakeholders the mitigation planning process, including the following actions:

Notices

The District announced mitigation planning via:

- Posting a notice on the District's website,
- Distributing the notice via e-mail to a wide audience of stakeholders,
- Publishing the notice in the following local newspaper: South Whidbey Record.

Copies of the above notices are included in Appendix 3.

Public Meetings

Public meetings were announced via the modes listed above and held on the following dates:

- Meeting 1 February 11, 2015 – Presentation of draft to school board.
- Meeting 2 May 25, 2016 – Presentation to board for approval.

Meeting agendas, minutes, and summary of attendees for the public meetings are included in Appendix 3.

Public Surveys

Public surveys were conducted to facilitate input about key aspects of the district's mitigation planning from district staff, parents, the public, and other stakeholders. The survey was available in both online and paper formats.

The full survey report is available in Appendix 3 (See attached Document).

Review and Comment on Mitigation Plan Drafts

Mitigation plan drafts were posted on the District's website for review, and the district received no substantive comments that required changes to the plan. Notices of the District's requests for comments being solicited from all interested parties were made via the district's web site. Copies of the notices are included in Appendix 3.

3.5 Review and Incorporation of Existing Plans, Studies, Reports, and Technical Information.

The South Whidbey School District's Hazard Mitigation Plan drew heavily on the content of the Washington State K–12 Facilities Hazard Mitigation Plan and the Pre-Disaster Mitigation parts of the Office of Superintendent of Public Instruction's ICOS (Inventory and Condition of Schools) database. ICOS includes a comprehensive database of school facility information, including condition assessments, remodeling, and modernization and other data bearing on school facilities.

The Pre-Disaster Mitigation part of ICOS was invaluable in providing GIS data for campus locations and for automating the processing and interpretation of technical data relating to natural hazards and the risks that arise from these hazards to the district's facilities and people.

ICOS is an actively maintained database that will be periodically updated, including hazard and risk data. Thus, the strong linkage between ICOS and the district's mitigation planning will keep the mitigation plan "alive" and current and will be especially helpful during the 5-year updates.

In addition to the data available through ICOS, the district also incorporated information from previous studies including:

ASCE 31-03 study of Langley Middle School from 2008.

ASCE 31-03 study of the Primary School from 2008.

4.0 GOALS, OBJECTIVES, AND ACTION ITEMS

4.1 Overview

The purpose of District Hazard Mitigation Plan is to reduce the impacts of future natural disasters on the district's facilities, students, staff and volunteers. That is, the purpose is to make the South Whidbey School District more disaster resistant and disaster resilient, by reducing the vulnerability to disasters and enhancing the capability to respond effectively to, and recover quickly from, future disasters.

Completely eliminating the risk of future disasters in the South Whidbey School District is neither technologically possible nor economically feasible. However, substantially reducing the negative impacts of future disasters is achievable with the adoption of this pragmatic Hazard Mitigation Plan and ongoing implementation of risk reducing action items. Incorporating risk reduction strategies and action items into the District's existing programs and decision making processes will facilitate moving the South Whidbey School District toward a safer and more disaster resistant future.

The South Whidbey School District Hazard Mitigation Plan is based on a four-step framework that is designed to help focus attention and action on successful mitigation strategies: Mission Statement, Goals, Objectives, and Action Items.

Mission Statement. The Mission Statement states the purpose and defines the primary function of the South Whidbey School District Hazard Mitigation Plan. The Mission Statement is an action-oriented summary that answers the question "Why develop a hazard mitigation plan?"

Goals. Goals identify priorities and specify how the South Whidbey School District intends to work toward reducing the risks from natural and human-caused hazards. The Goals represent the guiding principles toward which the District's efforts are directed. Goals provide focus for the more specific issues, recommendations, and actions addressed in Objectives and Action Items.

Objectives. Each Goal has Objectives which specify the directions, methods, processes, or steps necessary to accomplish the South Whidbey School District Hazard Mitigation Plan's Goals. Objectives lead directly to specific Action Items.

Action Items. Action Items are specific, well-defined activities or projects that work to reduce risk. That is, the Action Items represent the specific, implementable steps necessary to achieve the District's Mission Statement, Goals, and Objectives.

4.2 Mission Statement

The mission statement for the South Whidbey School District Hazard Mitigation Plan is to:

> **Proactively facilitate and support district-wide policies, practices, and programs that make the South Whidbey School District more disaster resistant and disaster resilient.**

Making the South Whidbey School District more disaster resistant and disaster resilient means taking proactive steps and actions to:

- Protect life safety,
- Reduce damage to district facilities,
- Minimize economic losses and disruption, and
- Shorten the recovery period from future disasters.

4.3 Mitigation Plan Goals and Objectives

The following Goals and Objectives serve as guideposts and checklists to begin the process of implementing mitigation Action Items to reduce identified risks to the District's facilities, students, staff, and volunteers from natural disasters.

The Goals and Objectives are consistent with those in the Washington State K–12 Facilities Hazard Mitigation Plan. However, the specific priorities, emphasis, and language in this mitigation plan are the South Whidbey School District's. These goals were developed with extensive input and priority setting by the South Whidbey District's hazard mitigation planning team, with inputs from district staff, volunteers, parents, students, and other stakeholders in the communities served by the District.

Goal 1: Reduce Threats to Life Safety

Reducing threats to life safety is the highest priority for the South Whidbey School District.

Objectives:

A. Enhance life safety by retrofitting existing buildings or replacing them with new current-code buildings and by locating and designing new schools to minimize life safety risk from future disaster events.

B. Develop robust disaster evacuation plans and conduct frequent practice drills. When evacuation is impossible in the anticipated warning time, consider vertical evacuation for tsunamis, other physical measures to shorten evacuation time, such as pedestrian bridges over rivers, or relocate campuses with extreme life safety risk to locations outside of hazard zones when possible.

C. Enhance life safety by improving public awareness of earthquakes, tsunamis, volcanic events, and other natural hazards that pose substantial life safety risk to the District's facilities, students, staff, and volunteers.

Goal 2: Reduce Damage to District Facilities, Economic Losses, and Disruption of the District's Services

Objectives:

A. Retrofit or replace existing buildings with a high vulnerability to one or more natural hazards to reduce damage, economic loss, and disruption in future disaster events.

B. Ensure that new facilities are adequately designed for hazard events and located outside of mapped high hazard zones to minimize damage and loss of function in future disaster events, to the extent practicable.

Goal 3: Enhance Emergency Planning, Disaster Response, and Post-Disaster Recovery

Objectives:

A. Enhance collaboration and coordination between the District, local governments, utilities, businesses, and citizens to prepare for, and recover from, future natural disaster events.

B. Enhance emergency planning to facilitate effective response and rapid recovery from future natural disaster events.

Goal 4: Increase Awareness and Understanding of Natural Hazards and Mitigation

Objectives:

A. Implement education and outreach efforts to increase awareness of natural hazards throughout the South Whidbey School District, including staff, parents, teachers, and the entire communities served by the District.

B. Maintain and publicize a natural hazards section in the high school library with FEMA and other publications and distribute FEMA and other brochures and other educational materials regarding natural hazards.

4.4 South Whidbey School District Hazard Mitigation Plan Action Items

Mitigation Action Items may include a wide range of measures such as: refinement of policies, studies, and data collection to better characterize hazards or risk, education, or outreach activities, enhanced emergency planning, partnership building activities, as well as retrofits to existing facilities or replacement of vulnerable facilities with new current-code buildings.

The 2016 South Whidbey School District's Hazard Mitigation Plan Action Items are summarized on the following page.

Table 4.1
South Whidbey School District Mitigation Action Items

Hazard	Action Item	Timeline	Source of Funds	Responsible Party	Plan Goals Addressed: Life Safety	Protect Facilities	Enhance Emergency Planning	Enhance Awareness and Education
Multi-Hazard Mitigation Action Items								
Long-Term #1	Integrate the findings and action items in the mitigation plan into ongoing programs and practices for the district.	Ongoing	District or Grants	Supt	X	X	X	X
Long-Term #2	Review emergency and evacuation planning to incorporate hazard and risk information from the mitigation plan.	Ongoing	District or Grants	Supt	X	X	X	X
Long-Term #3	Consider natural hazards whenever siting new facilities and locate new facilities outside of high hazard areas.	Ongoing	District or Grants	Supt	X	X	X	X
Long-Term #4	Ensure that new facilities are adequately designed to minimize risk from natural hazards.	Ongoing	District or Grants	Supt	X	X	X	X
Long-Term #5	Maintain, update and enhance facility data and natural hazards data in the ICOS database.	Ongoing	District or Grants	Supt	X	X	X	X
Long-Term #6	Develop and distribute educational materials regarding natural hazards, vulnerability and risk for K–12 facilities.	Ongoing	District or Grants	Supt	X		X	X
Long-Term #7	Seek FEMA funding for repairs if district facilities suffer damage in a FEMA declared disaster.	Ongoing	District or Grants	Supt	X	X		X
Long-Term #8	Pursue pre- and post-disaster mitigation grants from FEMA and other sources.	Ongoing	District or Grants	Supt	X	X		X
Long-Term #9	Post the district's mitigation plan on the website and encourage comments stakeholders for the ongoing review and periodic update of the mitigation plan.	Ongoing	District or Grants	Supt	X			X

Table 4.2South Whidbey School District Mitigation Action Items – Continued

Hazard	Action Item	Timeline	Source of Funds	Responsible Party	Plan Goals Addressed			
					Life Safety	Protect Facilities	Enhance Emergency Planning	Enhance Awareness and Education
Earthquake Mitigation Action Items								
Short-Term #1	Complete a life safety seismic retrofit for the North Gym at LMS, as funding becomes available	1-2 Years	District or Grants	Supt.	X	X		
Short-Term #2	Evaluate the seismic vulnerability of the 1950s portions of the Elementary and Middle Schools by having a structural engineer complete an ASCE 41-13 Tier 1 evaluation.	1-2 Years	District or Grants	Supt	X	X		X
Short-Term #3	Have a structural engineer review the drawings of the remodel of the High School to verify that necessary structural seismic mitigation measures were included. If not, complete an ASCE 41-13 Tier 1 evaluation.	1-2 Years	District or Grants	Supt	X	X		X
Short-Term #4	Assess the ASCE 41-13 results and select buildings or building parts that have the greatest vulnerability for more detailed evaluations.	1-3 Years	District or Grants	Supt	X	X		X
Short-Term #5	Evaluate the foundations of the portable buildings to determine whether they are adequate for earthquakes.	1-3 Years	District or Grants	Supt	X	X		X
Short-Term #6	Complete a life safety retrofit for the Primary Campus, as funding becomes available.	1-3 Years	District or Grants	Supt	X	X		
Short-Term #7	Anchor bolting of wood sill plates to the foundation at Langley Middle School	1-3 Years	District or Grants	Supt	X	X		
Long-Term #1	Prioritize and implement seismic retrofits or replacements based on the results of the detailed evaluations, as funding becomes available.	Ongoing	District or Grants	Supt	X	X		X
Long-Term #2	Maintain and update building data for seismic risk assessments in the OSPI ICOS PDM database.	Ongoing	District or Grants	Supt	X	X		X
Long-Term #3	Enhance emergency planning for earthquakes including duck and cover and evacuation drills.	Ongoing	District or Grants	Supt	X		X	X

Table 4.3
South Whidbey School District Mitigation Action Items – Continued

Hazard	Action Item	Timeline	Source of Funds	Responsible Party	Plan Goals Addressed			
					Life Safety	Protect Facilities	Enhance Emergency Planning	Enhance Awareness and Education
Wildland/Urban Interface Fire Mitigation Action Items								
Short-Term #1	Consult with Fire District #3 regarding level of fire risk for campuses for which this is recommended by the OSPI ICOS PDM database campus-level wildland/urban interface fire report.	1-2 Years	District or Grants	Supt	**X**	**X**	**X**	**X**
Short-Term #2	Enhance emergency evacuation planning for all campuses for which wildland/urban fires are possible.	1 year	District or Grants	Supt	**X**		**X**	**X**
Long-Term #1	Review defensible space around district facilities and implement mitigation measures to reduce fire risk, increase defensible space, and reduce potential fuel sources.	Ongoing	District or Grants	Supt	**X**	**X**	**X**	**X**

Table 4.3
South Whidbey School District Mitigation Action Items – Continued

Hazard	Action Item	Timeline	Source of Funds	Responsible Party	Plan Goals Addressed: Life Safety	Protect Facilities	Enhance Emergency Planning	Enhance Awareness and Education
Other Natural Hazards Mitigation Action Items								
Short-Term #1	Evaluate portable buildings to make sure that they are adequately tied down to resist high winds and implement mitigation measures, if necessary.	1-3 Years	District and Grants	Supt.	X	X		
Short-Term #2	Review and implement district emergency response plan for facilities	On-going	District and Grants	Supt.	X	X	X	X
Short-Term #3	Review and implement winter weather facility checklist.	On-going	District and Grants	Supt.	X	X	X	X
Short-Term #4	Review and update emergency response plan evacuation routes in terms of natural hazards.	On-going	District and Grants	Supt.	X		X	X
Short Term #5	Evaluate each district site and develop plan for tree trimming or removal to better protect facilities from damage due to severe weather.	1-3 Years	District and Grants	Supt.	X	X	X	X

5.0 Mitigation Plan Adoption, Implementation, and Maintenance: Template – Revised – June 10, 2015

Yellow highlighted sections are guidance for districts, once completed the highlight color should be removed.

5.1 Overview

For a hazard mitigation plan to be effective, it has to be implemented gradually over time, as resources become available. An effective plan must also be continually evaluated and periodically updated. The mitigation Action Items included in the South Whidbey School District's Hazard Mitigation Plan will be accomplished effectively only through a process which routinely incorporates logical thinking about hazards and cost-effective mitigation into ongoing decision making and capital improvement spending.

The following sections depict how the South Whidbey School District has adopted and will implement and maintain the vitality of the District's Hazard Mitigation Plan.

5.2 Plan Adoption

This is the South Whidbey School District's first Hazard Mitigation Plan, which became effective on Month XX, 2016, the date of adoption by the South Whidbey School District's Board. The Board adopted the District's Hazard Mitigation Plan following FEMA's approval of the District's submitted plan. The Board's adoption resolution is shown on the following page.

INSERT a scan of Board Adoption Resolution when signed, example below may be edited or replaced with district appropriate titles and wording.

Board of Directors Resolution Adopting the South Whidbey School District Hazard Mitigation Plan

Resolution Number 2016-X

A Resolution Adopting the 2016 South Whidbey School District Hazard Mitigation Plan

The South Whidbey School District resolves as follows:

Whereas, the South Whidbey School District has determined that it is in the best interest of the District to have an active hazard mitigation planning effort to reduce the long term risks from natural hazards to school facilities, and

Whereas, the South Whidbey School District recognizes that the Federal Emergency Management Agency (FEMA) requires the district to have an approved hazard mitigation plan as a condition of applying for and receiving FEMA mitigation project grant funding.

Now, therefore, be it resolved by the South Whidbey School District as follows:

The South Whidbey School District adopts the 2016 South Whidbey School District Hazard Mitigation Plan.

Passed by the School Board on the XXth day of Month, 2016.

Insert signature(s) and title(s) below.

Note: the school board's resolution is best done after FEMA approves the submitted plan because FEMA may require changes to be made to the submitted plan. With adoption after FEMA approval, the district's plan becomes active as of the adoption date and the plan must then be updated by the 5th anniversary of the adoption date. A plan update requires much less effort than creating the initial hazard mitigation plan.

5.3 Implementation

The Facility Director will have the lead responsibility for implementing the South Whidbey School District Hazard Mitigation Plan, with ongoing support from the district's Safety Committee.

5.3.1 Existing Authorities, Policies, Programs, Resources and Capabilities

The South Whidbey School District and all school districts in Washington have much narrower domains of authorities than do cities and counties. The district's responsibilities are limited to constructing and maintaining its facilities and providing educational services for the district's students. The district's authorities are limited to these two areas.

The district's policies and programs related to hazard mitigation planning are limited to the criteria for siting new schools, design of new school buildings, maintenance of buildings and periodic modernization of buildings. The district's resources for these programs include district staff involved with siting, construction, maintenance and modernization of schools, supplemented by contractor and consultants when needed.

The completion of the South Whidbey District's Hazard Mitigation Plan has substantially raised the district's awareness and knowledge of natural hazards. Consideration of natural hazards will be included in siting of new schools, the design of new school buildings. Furthermore, mitigation measures to reduce risks from natural hazards will be incorporated into maintenance and modernization of buildings whenever possible.

The South Whidbey School District has the necessary human resources to ensure that the South Whidbey School District Hazard Mitigation Plan continues to be an actively used planning document. District staff has been active in the preparation of the Plan, and have gained an understating of the process and the desire to integrate the Plan into ongoing capital budget planning. Through this linkage, the District's Hazard Mitigation Plan will be kept active and be a working document.

District staff has broad experience with planning and facilitation of community inputs. This broad experience is directly applicable to hazard mitigation planning and to implementation of mitigation projects. If specialized expertise is necessary for a particular project, the District will contract with a consulting firm on an as-needed basis.

Furthermore, recent earthquake and tsunami disasters worldwide serve as a reminder of need to maintain a high level of interest in evaluating and mitigating risk from natural disasters of all types. These events have kept the interest in hazard mitigation planning and implementation alive among the South Whidbey School District Board, District staff and in the communities served by the District.

To ensure efficient, effective and timely implementation of the identified mitigation action items, the South Whidbey School District will use the full range of its capabilities and resources and those of the community. The district's goal is to implement as many of the elements of its mitigation strategy (Action Items) over the next five years as possible, commensurate with the extent of funding that becomes available. This effort will be led by the Superintendent with the full support of the School Board, and with outreach and cooperation with the community, the region and the state, especially with the Office of Superintendent of Public Instruction.

Regulatory Tools (Ordinances and Codes)

- RCW 28A – Common School Provisions
- WAC Title 392 – Office of Superintendent of Public Instruction
- Other

Administrative Tools (Departments, Organizations, Programs)

SOUTH WHIDBEY School District Resources

- School Board
- Superintendent
- Parent Teacher Association
- Teachers Association/Union
- Safety Committee
- Other

Regional and State Resources

- Office of Superintendent of Public Instruction
- Washington State School Directors' Association - WSSDA
- Washington Association of School Administrators - WASA
- Washington Association of School Business Officials – WASBO
- Washington Association of Maintenance and Operation Administrators - WAMOA
- Rapid Responder System Education Service District - 189.
- Island County, including Emergency Management, Public Works and GIS, Planning Department and Building Officials.
- City of Langley, including Emergency Management, Public Works and GIS, Planning Department and Building Officials
- South Whidbey Fire / EMS
- Langley Police Department
- Island County Sheriff
- Other First Responders
- Other

Other Technical Tools (Plans and Others)

South Whidbey School District Capabilities

- District Website
- School Closure Telephone Plan
- Evacuation Plans
- Lockdown Plans
- Fire Drills
- Earthquake Drills
- Bomb Threat Assessment Guide
- Emergency Response Plan
- Capital Facilities Plan
- Five Year Plan
- Strategic Plan
- Policies and Procedures
- Student Rights and Responsibilities
- District Emergency Plan
- Other

Regional Capabilities

- Island County Department of Emergency Management
    - Hazard Identification and Vulnerability Assessment
    - Comprehensive Emergency Management Plan
    - Emergency Operation Plan
    - Multi-Jurisdiction Hazard Mitigation Plan
    - NIMS Implementation Plan
- Other

Fiscal Tools (Taxes, Bonds, Funds and Fees)

SOUTH WHIDBEY School District Capabilities

- Authority to Levy Taxes
- Authority to Issue Bonds
- Funds
    - General Fund
    - Capital Project Funds

    - Transportation Vehicle Fund
    - Other Fund
- **External Funds**
    - OSPI School Construction Assistance Program–Modernization / New in Lieu
    - FEMA Grants
    - HUD “CDBG” Grants
    - Foundation Grants
    - Legislative Funding/Grants
    - Other Grants
    - Other

Other SOUTH WHIDBEY School District Capabilities

- Other

5.3.2 Integration into Ongoing Programs

As noted above, the South Whidbey School District’s ongoing programs are more narrowly defined than those for cities and counties.

An important aspect of the Plan’s integration into ongoing programs will be the inclusions of the mitigation plan’s hazard, vulnerability and risk evaluations and mitigation Action Items, into ongoing capital improvement planning and other district activities, such as building maintenance, periodic remodeling or modernization of facilities and future siting and construction of new facilities.

For example, in evaluating a possible remodeling or modernization of buildings, the district will consider include retrofits to reduce the vulnerability to natural hazards as well as considering other alternatives such as replacement with a new building, when the retrofit is very expensive or a site has substantial risks from natural hazards that cannot be mitigated on the existing site.

5.3.3 Prioritization of Mitigation Projects

Prioritization of future mitigation projects within the South Whidbey School District requires flexibility because of varying types of projects, District needs and availability funding sources. Prioritized mitigation Action Items developed during the mitigation planning process are summarized in Chapter 4. Additional mitigation Action Items or revisions to the initial Action Items are likely in the future. The South Whidbey School District Board will make final decisions about implementation and priorities with inputs from district staff, the mitigation planning team, the public and other stakeholders.

The South Whidbey School District's prioritization of mitigation projects will include the following factors:

1. The mission statement and goals in the South Whidbey School District Hazard Mitigation Plan including:

   Goal 1: Reduce Threats to Life Safety,

   Goal 2: Reduce Damage to District Facilities, Economic Losses and Disruption of the District's Services,

   Goal 3: Enhance Emergency Planning, Disaster Response and Disaster Recovery, and

   Goal 4: Increase Awareness and Understanding of Natural Hazards and Mitigation

2. Benefit-cost analysis to ensure that mitigation projects are cost effective, with benefit exceeding the costs.

3. The STAPLEE process to ensure that mitigation Action Items under consideration for implementation meet the needs and objectives of the District, its communities, and citizens, by considering the social, technical, administrative, political, economic and environmental aspects of potential projects.

Cost Effectiveness of Mitigation Projects

As the South Whidbey School District considers whether or not to undertake specific mitigation projects or evaluate how to decide between competing mitigation projects, they must address questions that don't always have obvious answers, such as:

What is the nature of the hazard problem?
How frequent and how severe are the hazard events of concern?
Do we want to undertake mitigation measures?
What mitigation measures are feasible, appropriate, and affordable?
How do we prioritize between competing mitigation projects
Are our mitigation projects likely to be eligible for FEMA funding?

The South Whidbey School District recognizes that benefit-cost analysis is a powerful tool that can help provide solid, defensible answers to these difficult socio-political-economic-engineering questions. Benefit-cost analysis is required for all FEMA-funded mitigation projects, under both pre-disaster and post-disaster mitigation programs.

However, regardless of whether or not FEMA funding is involved, benefit-cost analysis provides a sound basis for evaluating and prioritizing possible mitigation projects for any natural hazard. Thus, the district will use benefit-cost analysis and related economic tools, such as cost-effectiveness evaluation, to the extent practicable in prioritizing and implementing mitigation actions.

STAPLEE Process

The South Whidbey School District will also use the STAPLEE methodology to evaluate projects based on the Social, Technical, Administrative, Political, Legal, Economic, and Environmental (STAPLEE) considerations and opportunities for implementing particular mitigation action items in the district. The STAPLEE approach is helpful for doing a quick analysis of the feasibility of proposed mitigation projects.

The following paragraphs outline the district's STAPLEE Approach

Social:

- Is the proposed action socially acceptable to the community?
- Are there equity issues involved that would mean that one segment of the community is treated unfairly?
- Will the action cause social disruption?

Technical:

- Will the proposed action work?
- Will it create more problems than it solves?
- Does it solve a problem or only a symptom?
- Is it the most useful action in light of other goals?

Administrative:

- Is the action implementable?
- Is there someone to coordinate and lead the effort?
- Is there sufficient funding, staff, and technical support available?
- Are there ongoing administrative requirements that need to be met?

Political:

- Is the action politically acceptable?
- Is there public support both to implement and to maintain the project?

Legal: Include legal counsel, land use planners, and risk managers in this discussion.

- Who is authorized to implement the proposed action?
- Is there a clear legal basis or precedent for this activity?
- Will the district be liable for action or lack of action?
- Will the activity be challenged?

Economic:

- What are the costs and benefits of this action?
- Do the benefits exceed the costs?
- Are initial, maintenance, and administrative costs taken into account?
- Has funding been secured for the proposed action? If not, what are the potential funding sources (public, non-profit, and private)?
- How will this action affect the fiscal capability of the district?
- What burden will this action place on the tax base or economy?
- What are the budget and revenue effects of this activity?

Environmental:

- How will the action impact the environment?
- Will the action need environmental regulatory approvals?
- Will it meet local and state regulatory requirements?
- Are endangered or threatened species likely to be affected?

5.4 Plan Maintenance and Periodic Updating

5.4.1 Periodic Monitoring, Evaluating and Updating

Monitoring the South Whidbey School District Hazard Mitigation Plan is an ongoing, long-term effort. An important aspect of monitoring is a continual process of ensuring that mitigation Action Items are compatible with the goals, objectives, and priorities established during the development of the District's Mitigation Plan. The District has developed a process for regularly reviewing and updating the Hazard Mitigation Plan. As noted previously, the Facility Director will have the lead responsibility for implementing the South Whidbey School District's Hazard Mitigation Plan and for periodic monitoring, evaluating and updating of the Plan. There will be ample opportunities to incorporate mitigation planning into ongoing activities and to seek grant support for specific mitigation projects.

The South Whidbey School District Hazard Mitigation Plan will be reviewed annually as well as after any significant disaster event affecting the District. These reviews will determine whether there have been any significant changes in the understanding of hazards, vulnerability and risk or any significant changes in goals, objectives and Action Items. These reviews will provide opportunities to incorporate new information into the Mitigation Plan, remove outdated items and document completed Action Items. This will also be the time to recognize the success of the District in implementing Action Items contained in the Plan. Annual reviews will also focus on identifying potential funding sources for the implementation of mitigation Action Items.

The periodic monitoring, evaluation and updating will assess whether or not, and to what extent, the following questions are applicable:

1. Do the plans goals, objectives and action items still address current and future expected conditions?
2. Do the mitigation Action Items accurately reflect the District's current conditions and mitigation priorities?
3. Have the technical hazard, vulnerability, and risk data been updated or changed?
4. Are current resources adequate for implanting the District's Hazard Mitigation Plan? If not are there other resources that may be available?
5. Are there any problems or impediments to implementation? If so, what are the solutions?
6. Have other agencies, partners, and the public participated as anticipated? If no, what measures can be taken to facilitate participation?
7. Have there been changes in federal and/or state laws pertaining to hazard mitigation in the District?
8. Have the FEMA requirements for the maintenance and updating of hazard mitigation plans changed?
9. What can the District learn from declared federal and/or state hazard events in other Washington school districts that share similar characteristics to the South Whidbey School District, such as vulnerabilities to earthquakes and tsunamis?
10. How have previously implemented mitigation measures performed in recent hazard events? This may include assessment of mitigation Action Items similar to those contained in the District's Mitigation Plan, but where hazard events occurred outside of the District.

The Safety Committee will review the results of these mitigation plan assessments, identify corrective actions and make recommendations, if necessary, to the South Whidbey School Board for actions that may be necessary to bring the Hazard Mitigation Plan back into conformance with the stated goals and objectives. Any major revisions of the Hazard Mitigation Plan will be taken to the Board for formal approval as part of the District's ongoing mitigation plan maintenance and implementation program.

The Safety Committee will have lead responsibility for the formal updates of the Hazard Mitigation Plan every five years. The formal update process will be initiated at least one year before the five-year anniversary of FEMA approval of the South Whidbey School District Hazard Mitigation Plan, to allow ample time for robust participation by stakeholders and the public and for updating data, maps, goals, objectives and Action Items.

5.4.2 Continued Public Involvement and Participation

Implementation of the mitigation actions identified in the Plan must continue to engage the entire community. Continued public involvement will be an integral part of the ongoing process of incorporating mitigation planning into land use planning, zoning, and capital improvement plans and related activities within the communities served by the District. In addition, the District will expand communications and joint efforts between the District and emergency management activities in the city of Langley and Island County.

The 2016 South Whidbey School District Hazard Mitigation Plan will be available on the District's website and hard copies will be placed in the school and public libraries. The existence and locations of these hard copies will be posted on the District's website along with contact information so that people can direct comments, suggestions and concerns to the appropriate staff.

The South Whidbey School District is committed to involving the public directly in the ongoing review and updating of the Hazard Mitigation Plan. This public involvement process will include public participation in the monitoring, evaluation and updating processes outlined in the previous section. Public involvement will intensify as the next 5-year update process is begun and completed.

A press release requesting public comments will be issued after each major update and also whenever additional public inputs are deemed necessary. The press release will direct people to the website and other locations where the public can review proposed updated versions of the South Whidbey School District's Hazard Mitigation Plan. This process will provide the public with accessible and effective means to express their concerns, opinions, ideas about any updates/changes that are proposed to the Mitigation Plan. The District will ensure that the resources are available to publicize the press releases and maintain public participation through web pages, social media, newsletters and newspapers.

6.0 EARTHQUAKES

6.1 Introduction

Every location in Washington State has some level of earthquake hazard, but the level of earthquake hazard varies widely by location within the state. Historically, awareness of seismic risk in Washington has generally been high, among both the public and public officials. This awareness in based to a great extent on the significant earthquakes that occurred within the Puget Sound area in 1949 (Olympia earthquake), 1965 (Tacoma earthquake) and 2001(Nisqually earthquake), as well as on other smaller earthquakes in many locations throughout the state.

The awareness of seismic risk in Washington has also increased in recent years due to the devastating earthquakes and tsunamis in Indonesia in 2004 and Japan in 2011. The geologic settings for the Indonesia and Japan earthquakes are very similar to the Cascadia Subduction Zone along the Washington Coast.

The technical information in the following sections provides a basic understanding of earthquake hazards, which is an essential foundation for making well-informed decisions about earthquake risks and mitigation Action Items for K–12 facilities.

6.2 Washington Earthquakes

Earthquakes are described by their magnitude (M), which is a measure of the total energy released by an earthquake. The most common magnitude is called the "moment magnitude," which is calculated by seismologists from two factors – 1) the amount of slip (movement) on the fault causing the earthquake and 2) the area of the fault surface that ruptures during the earthquake. Moment magnitudes are similar to the Richter magnitude, which was used for many decades but has now been replaced.

The moment magnitudes for the largest earthquakes recorded worldwide and in Washington are shown below.

Table 6.1
Largest Recorded Earthquakes[1,2]

Worldwide	Magnitude	Washington	Magnitude
1960 Chile	9.5	1872 Chelan	6.8[a]
1964 Prince William Sound, Alaska	9.2	1949 Olympia	6.8
2004 Sumatra, Indonesia	9.1	2001 Nisqually	6.8
2011 Japan	9.0	1965 Tacoma	6.7
1952 Kamchatka, Russia	9.0	1939 Bremerton	6.2
2010 Chile	8.8	1936 Walla Walla	6.1
1906 Ecuador	8.8	1909 Friday Harbor	6.0

[a] Estimated magnitude.

Figure 6.1
Epicenters of Historic Earthquakes in Washington with Magnitudes of 3.0 or Higher[3]

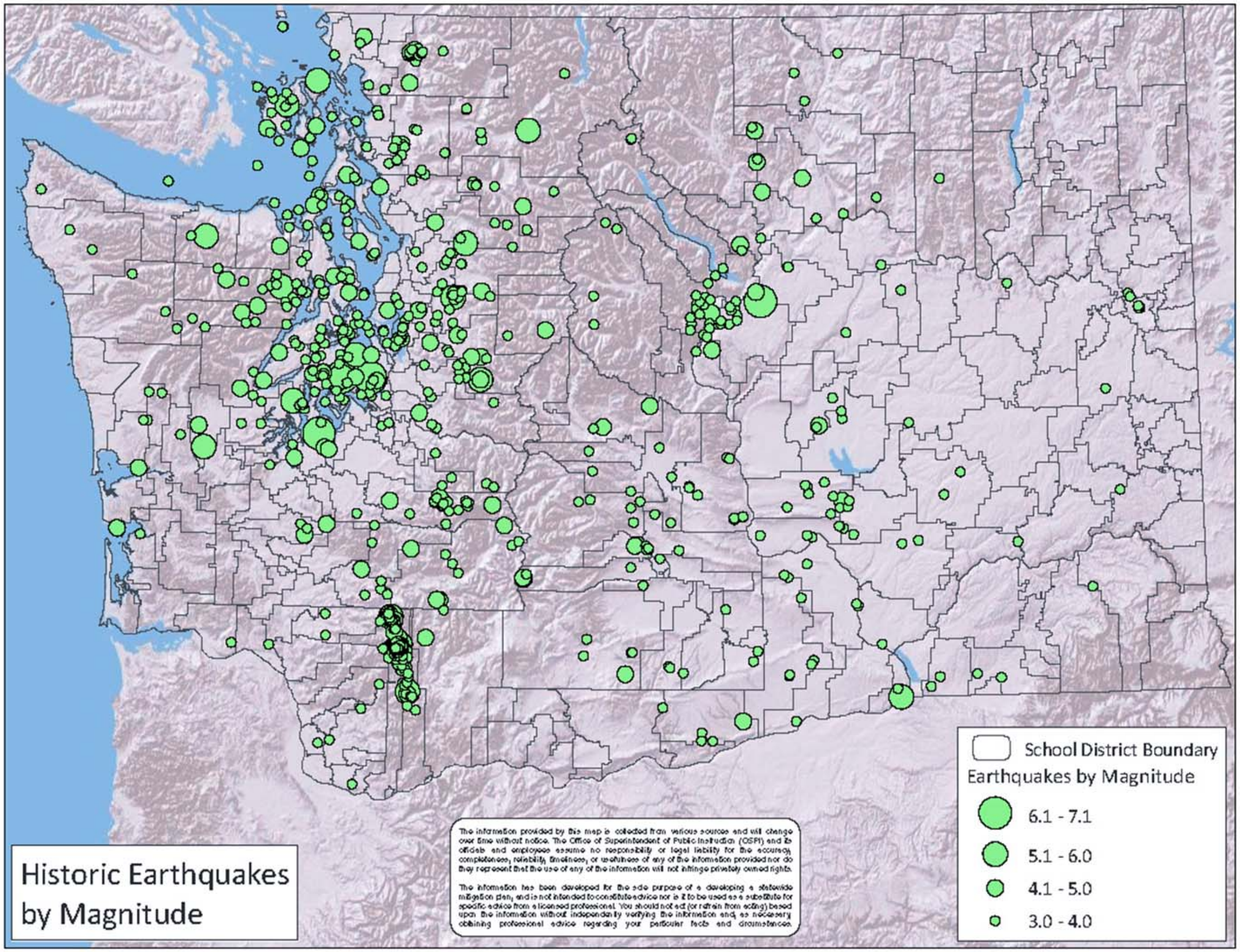


Table 6.1 and Figure 6.1 do not include the January 26, 1700 earthquake on the Cascadia Subduction Zone which has been identified by tsunami records in Japan and paleoseismic investigations along the Washington Coast. The estimated magnitude of the 1700 earthquake is approximately 9.0. This earthquake is not shown in Table 5.1 because it predates modern seismological records. However, this earthquake is among the largest known earthquakes worldwide and the largest earthquake affecting Washington over the past several hundred years. The closest analogy to this earthquake and its effects, including tsunamis, is the 2011 Japan earthquake.

Earthquakes in Washington, and throughout the world, occur predominantly because of plate tectonics – the relative movement of plates of oceanic and continental rocks that make up the rocky surface of the earth. Earthquakes can also occur because of volcanic activity and other geological processes.

The Cascadia Subduction Zone is a geologically complex area off the Pacific Northwest coast that ranges from Northern California to British Columbia. In simple terms, several pieces of oceanic crust (the Juan de Fuca Plate and other smaller pieces) are being subducted (pushed under) the crust of the North American Plate. This subduction process is responsible for most of the earthquakes in the Pacific Northwest and for creating the chain of volcanoes in the Cascade Mountains.

Figure 6.2 on the following page shows the geologic (plate-tectonic) setting of the Cascadia Subduction Zone.

There are three main types of earthquakes that affect Washington State:

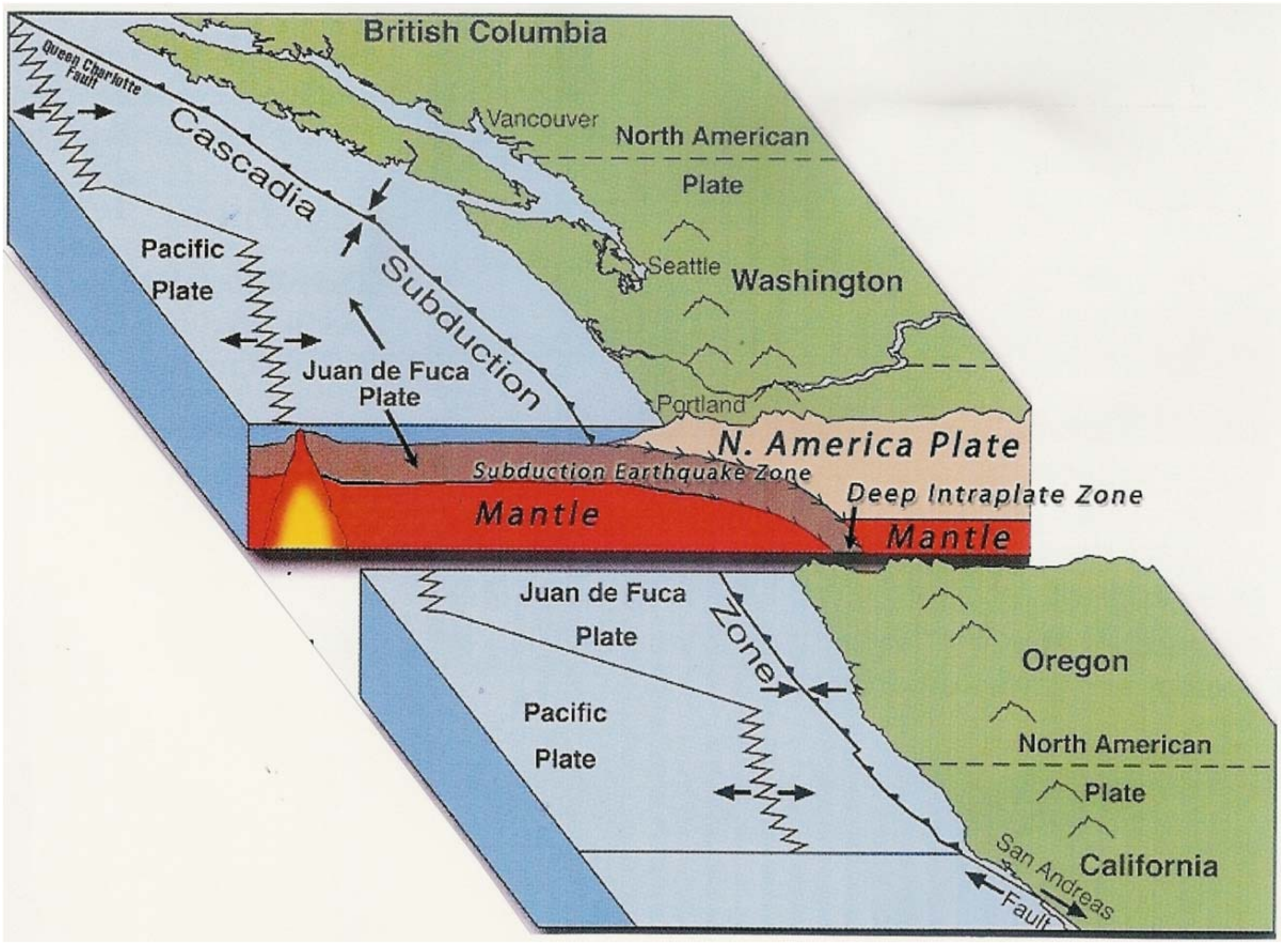
1) "Interface" earthquakes on the boundary between the subducting Juan de Fuca Plate and the North American Plate,

2) "Intraplate" earthquakes within the subducting oceanic plates, and

3) "Crustal" earthquakes within the North American Plate.

"Interface" earthquakes on the Cascadia Subduction Zone occur on the boundary between the subducting Juan de Fuca plate and the North American Plate. These earthquakes may have magnitudes up to 9.0 or perhaps 9.2, with average return periods (the time period between earthquakes) of about 250 to 500 years. These are the great Cascadia Subduction Zone earthquake events that have received attention in the popular press. The last major interface earthquake on the Cascadia Subduction Zone occurred on January 26, 1700. These earthquakes occur about 40 miles offshore from the Pacific Ocean coastline. Ground shaking from such earthquakes would be the strongest near the coast and strong ground shaking would be felt throughout much of western Washington, with the level of shaking decreasing further inland from the coast.

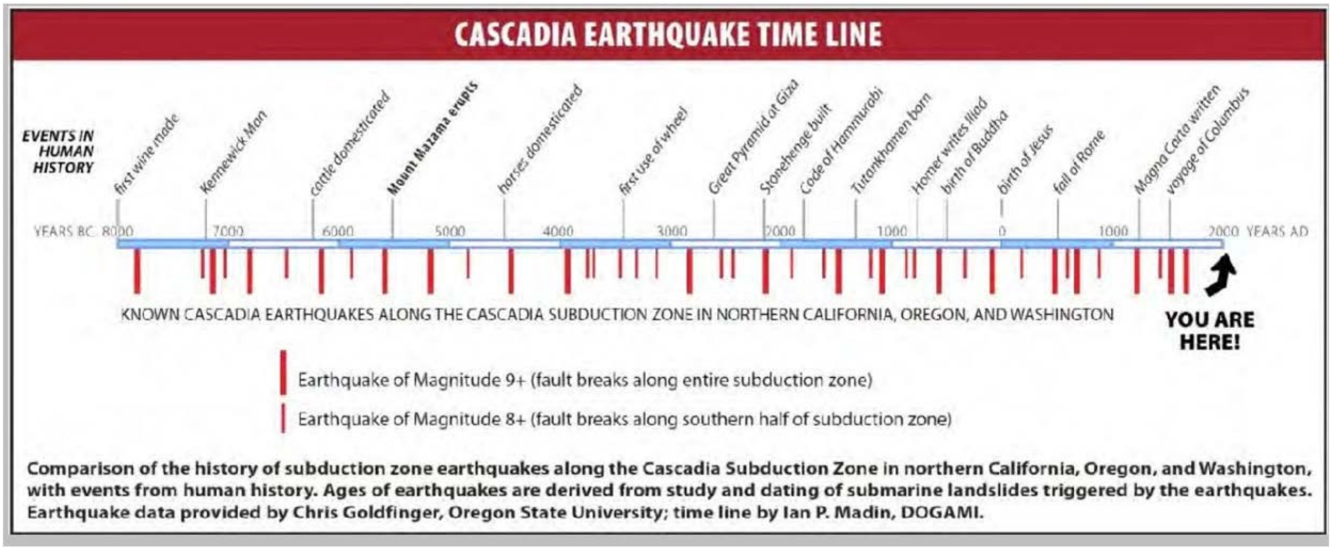
Figure 6.2
Cascadia Subduction Zone[4]



Paleo seismic investigations, which look at geologic sediments and rocks, for signs of ancient earthquakes, have identified 41 Cascadia Subduction Zone interface earthquakes over the past 10,000 years, which corresponds to one earthquake about every 250 years. Of these 41 earthquakes, about half are M9.0 or greater earthquakes that represent a full rupture of the fault zone from Northern California to British Columbia. The other half of the interface earthquakes represents M8+ earthquakes that rupture only the southern portion of the subduction zone.

The 300+ years since the last major Cascadia Subduction Zone earthquake is longer than the average timeframe of about 250 years for M8 or greater and is shorter than some of the intervals between M9.0 earthquakes. The time history of these major interface earthquakes is shown in Figure 6.3 on the following page.

Figure 6.3
Time History of Cascadia Subduction Zone Interface Earthquakes[5]



"Intraplate" earthquakes occur within the subducting Juan de Fuca Plate. These earthquakes may have magnitudes up to about 4.5, with probable return periods of about 500 to 1000 years at any given location. These earthquakes can occur anywhere along the Cascadia Subduction Zone. The 1949, 1965 and 2001 earthquakes listed in Table 1 are examples of intraplate earthquakes. These earthquakes occur deep in the earth's crust, about 20 to 30 miles below the surface. They generate strong ground motions near the epicenter, but have damaging effects over significantly smaller areas than the larger magnitude interface earthquakes discussed above.

"Crustal" earthquakes occur within the North American Plate. Crustal earthquakes are shallow earthquakes, typically within the upper 5 or 10 miles of the earth's surface, although some ruptures may reach the surface. In Western Washington crustal earthquakes are mostly related to the Cascadia Subduction Zone. Crustal earthquakes are known to occur not only on faults mapped as active or potentially active, but also on unknown faults. Many significant earthquakes in the United States have occurred on previously unknown faults.

Based on the historical seismicity in Washington State and on comparisons to other geologically similar areas, small to moderate crustal earthquakes up to about M5 or M5.5 are possible almost any place in Washington. There is also a possibility of larger crustal earthquakes in the M6+ range on unknown faults, although, the probability of such events is likely to be low.

6.3 Earthquake Concepts for Risk Assessments

6.3.1 Earthquake Magnitudes

In evaluating earthquakes, it is important to recognize that the earthquake magnitude scale is not linear, but rather logarithmic (based on intervals corresponding to orders of magnitude). For example, each one step increase in magnitude, such as from M7 to M8, corresponds to an increase in the amount of energy released by the earthquake of a factor of about 30, based on the mathematics of the magnitude scale.

Thus, a M7 earthquake releases about 30 times more energy than a M6, while a M8 releases about 30 times more energy than a M7 and so on. Thus, a great M9 earthquake releases nearly 1,000 times (30 [M7] x 30 [M8]) more energy than a large earthquake of M7 and nearly 30,000 times more energy than a M6 earthquake (30 [M6] x 30 [M7] x 30 [M8]).

The public often assumes that the larger the magnitude of an earthquake, the "worse" it is. That is, the "big one" is a M9 earthquake and smaller earthquakes such as M6 or M7 are not the "big one". However, this is true only in very general terms. Higher magnitude earthquakes do affect larger geographic areas, with much more widespread damage than smaller magnitude earthquakes. However, for a given site, the magnitude of an earthquake is <u>not</u> a good measure of the severity of the earthquake at that site.

For most locations, the best measure of the severity of an earthquake is the intensity of ground shaking. However, for some sites, ground failures and other possible consequences of earthquakes, which are discussed later in this chapter (Section 6.6), may substantially increase the severity.

For any earthquake, the severity and intensity of ground shaking at a given site depends on four main factors:

- Earthquake magnitude,
- Earthquake epicenter, which is the location on the earth's surface directly above the point of origin of an earthquake,
- Earthquake depth, and
- Soil or rock conditions at the site, which may amplify or deamplify earthquake ground motions.

An earthquake will generally produce the strongest ground motions near the epicenter (the point on the ground above where the earthquake initiated) with the intensity of ground motions diminishing with increasing distance from the epicenter. The intensity of ground shaking at a given location depends on the four factors listed above. Thus, for any given earthquake there will be contours of varying intensity of ground shaking vs. distance from the epicenter. The intensity will generally decrease with distance from the epicenter, and often in an irregular pattern, not simply in perfectly shaped concentric circles. This irregularity is caused by soil conditions, the complexity of earthquake fault rupture patterns, and possible directionality in the dispersion of earthquake energy.

The amount of earthquake damage and the size of the geographic area affected generally increase with earthquake magnitude. Below are some qualitative examples:

- Earthquakes below about M5 are not likely to cause significant damage, even locally very near the epicenter.
- Earthquakes between about M5 and M6 are likely to cause moderate damage near the epicenter.
- Earthquakes of about M6.5 or greater (e.g., the 2001 Nisqually earthquake) can cause major damage, with damage usually concentrated fairly near the epicenter.

- Larger earthquakes of M7+ cause damage over increasingly wider geographic areas with the potential for very high levels of damage near the epicenter.
- Great earthquakes with M8+ can cause major damage over wide geographic areas.
- A mega-quake M9 earthquake on the Cascadia Subduction Zone could affect the entire Pacific Northwest from British Columbia, through Washington and Oregon, and as far south as Northern California, with the highest levels of damage near the coast.

6.3.2 Intensity of Ground Shaking

There are many measures of the severity or intensity of earthquake ground motions. The Modified Mercalli Intensity scale (MMI) was widely used beginning in the early 1900s. MMI is a descriptive, qualitative scale that relates severity of ground motions to the types of damage experienced. MMIs range from I to XII. More accurate, quantitative measures of the intensity of ground shaking have largely replaced the MMI. These modern intensity scales are used in the South Whidbey School District Hazard Mitigation Plan.

Modern intensity scales use terms that can be physically measured with seismometers (instruments that measure motions of the ground), such as acceleration, velocity, or displacement (movement). The intensity of earthquake ground motions may also be measured in spectral (frequency) terms, as a function of the frequency of earthquake waves propagating through the earth. In the same sense that sound waves contain a mix of low-, moderate- and high-frequency sound waves, earthquake waves contain ground motions of various frequencies. The behavior of buildings and other structures depends substantially on the vibration frequencies of the building or structure vs. the spectral content of earthquake waves. Earthquake ground motions also include both horizontal and vertical components.

A common physical measure of the intensity of earthquake ground shaking, and the one used in this mitigation plan, is Peak Ground Acceleration (PGA). PGA is a measure of the intensity of shaking, relative to the acceleration of gravity (g). For example, an acceleration of 1.0 g PGA is an extremely strong ground motion that may occurs near the epicenter of large earthquakes. With a vertical acceleration of 1.0 g, objects are thrown into the air. With a horizontal acceleration of 1.0 g, objects accelerate sideways at the same rate as if they had been dropped from the ceiling. 10% g PGA means that the ground acceleration is 10% that of gravity, and so on.

Damage levels experienced in an earthquake vary with the intensity of ground shaking and with the seismic capacity of structures. The following generalized observations provide qualitative statements about the likely extent of damages from earthquakes with various levels of ground shaking (PGA) at a given site:

- Ground motions of only 1% g or 2% g are widely felt by people; hanging plants and lamps swing strongly, but damage levels, if any, are usually very low.
- Ground motions below about 10% g usually cause only slight damage.
- Ground motions between about 10% g and 30% g may cause minor to moderate damage in well-designed buildings, with higher levels of damage in more vulnerable buildings. At this level of ground shaking, some poorly designed buildings may be subject to collapse.

- Ground motions above about 30% g may cause significant damage in well-designed buildings and very high levels of damage (including collapse) in poorly designed buildings.
- Ground motions above about 50% g may cause significant damage in many buildings, including some buildings that have been designed to resist seismic forces.

6.4 Earthquake Hazard Maps

The current scientific understanding of earthquakes is incapable of predicting exactly where and when the next earthquake will occur. However, the long term probability of earthquakes is well enough understood to make useful estimates of the probability of various levels of earthquake ground motions at a given location.

The current consensus estimates for earthquake hazards in the United States are incorporated into the 2014 USGS National Seismic Hazard Maps. These maps are the basis of building code design requirements for new construction, per the International Building Code adopted in Washington State. The earthquake ground motions used for building design are set at 2/3rds of the 2% in 50 year ground motion.

The following maps show contours of Peak Ground Acceleration (PGA) with 10% and 2% chances of exceedance over the next 50 years to illustrate the levels of seismic hazard. The ground shaking values on the maps are expressed as a percentage of g, the acceleration of gravity. For example, the 10% in 50 year PGA value means that over the next 50 years there is a 10% probability of this level of ground shaking or higher.

In very qualitative terms, the 10% in 50 year ground motion represents a likely earthquake while the 2% in 50 year ground motion represents a level of ground shaking close to but not the absolute worst case scenario.

Figure 6.4 on the following page, the statewide 2% in 50 year ground motion map, is the best statewide representation of the variation in the level of seismic hazard in Washington State by location:

- The dark red, pink and orange areas have the highest levels of seismic hazard.
- The tan, yellow and blue areas have intermediate levels of seismic hazard.
- The bright green and pale green areas have the lowest levels of seismic hazard.

The detailed geographical patterns in the maps reflect the varying contributions to seismic hazard from earthquakes on the Cascadia Subduction Zone and crustal earthquakes within the North American Plate. The differences in geographic pattern between the 2% in 50 year maps and the 10% in 50 year maps reflect different contributions from Cascadia Subduction Zone earthquakes and crustal earthquakes.

These maps are generated by including earthquakes from all known faults, taking into account the expected magnitudes and frequencies of earthquakes for each fault. The maps also include contributions from unknown faults, which are statistically possible anywhere in Washington. The contributions from unknown faults are included via “area” seismicity which is distributed throughout the state.

An important caveat for interpreting these maps is that the 2014 USGS seismic hazard maps show the level of ground motions for rock sites. Ground motions on soil sites, especially soft soil sites will be significantly higher than for rock sites. Thus, for earthquake hazard analysis at a given site it is essential to include consideration of the site’s soil conditions.

The ground motions shown in the following figures represent ground motions with the specified probabilities of occurrence. At any given site, earthquakes may be experienced with ground motions over the entire range of levels of ground shaking from just detectible with sensitive seismometers to higher than the 2% in 50 year ground motion

Figure 6.4
2014 USGS Seismic Hazard Map: Washington State[6]
PGA value (%g) with a 2% Chance of Exceedance in 50 years

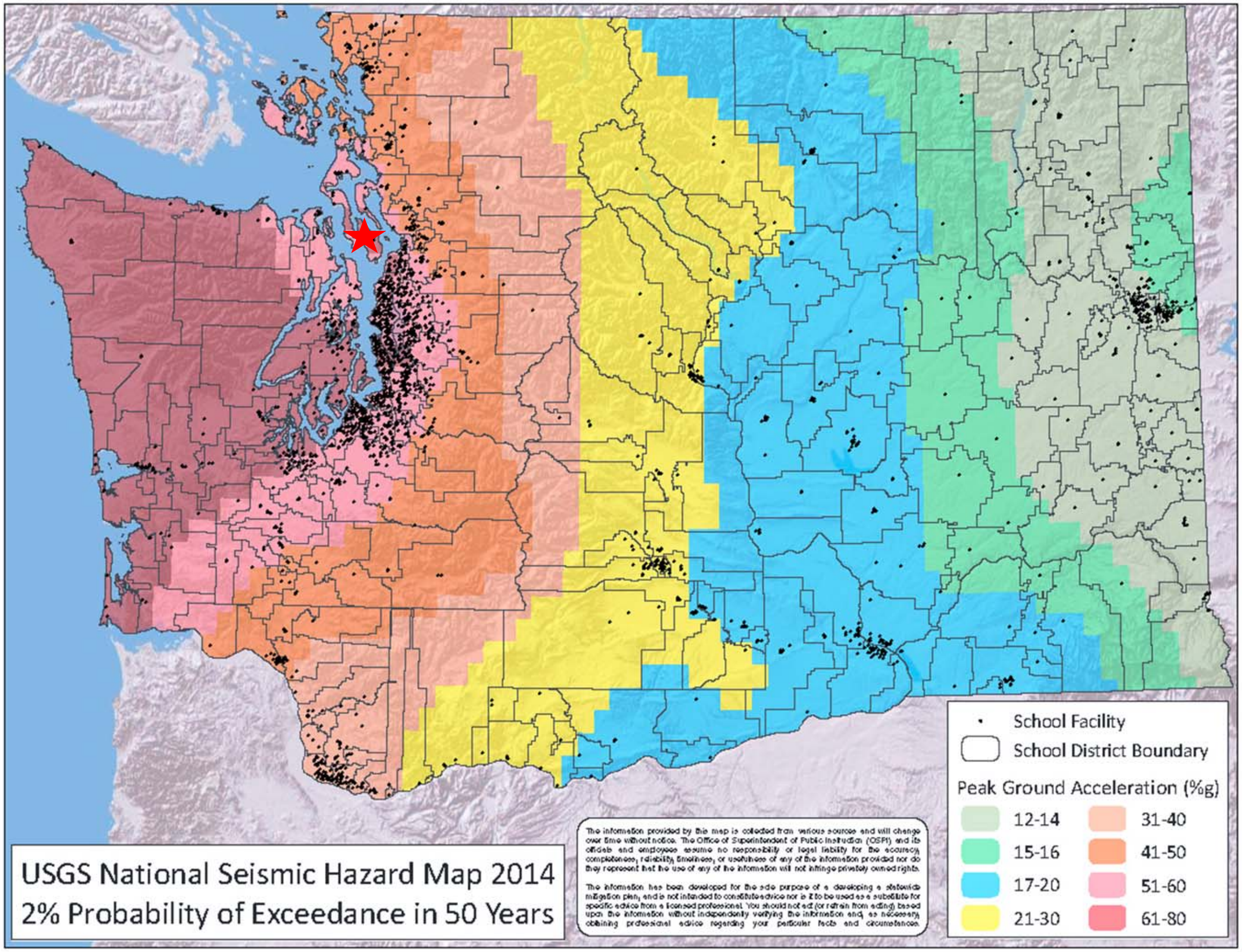


Figure 6.5
2014 USGS Seismic Hazard Map: Washington State[6]
PGA value (%g) with a 10% Chance of Exceedance in 50 years

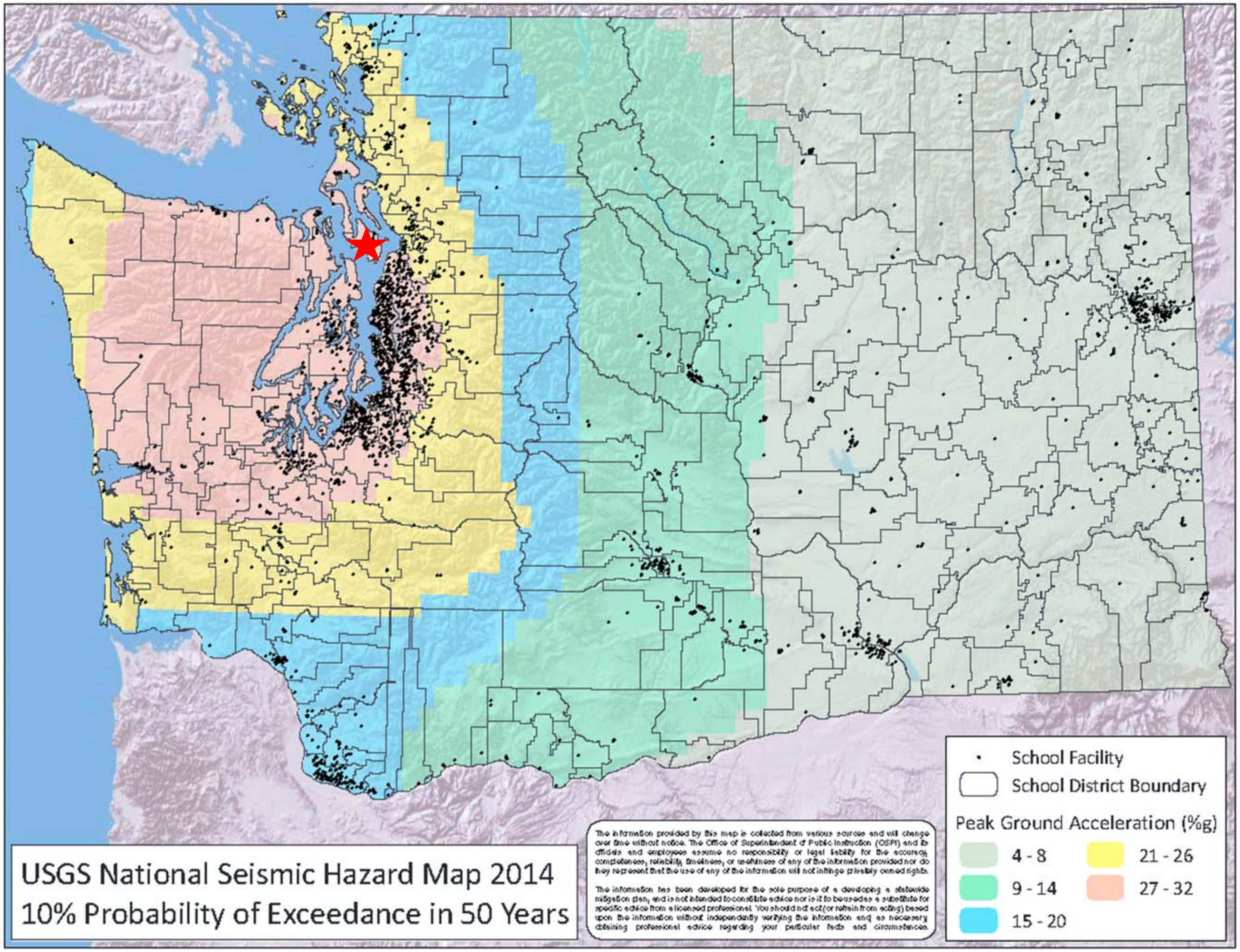


Figure 6.6
2014 USGS Seismic Hazard Map: Puget Sound Area
PGA value (percent g) with a 2% Chance of Exceedance in 50 years

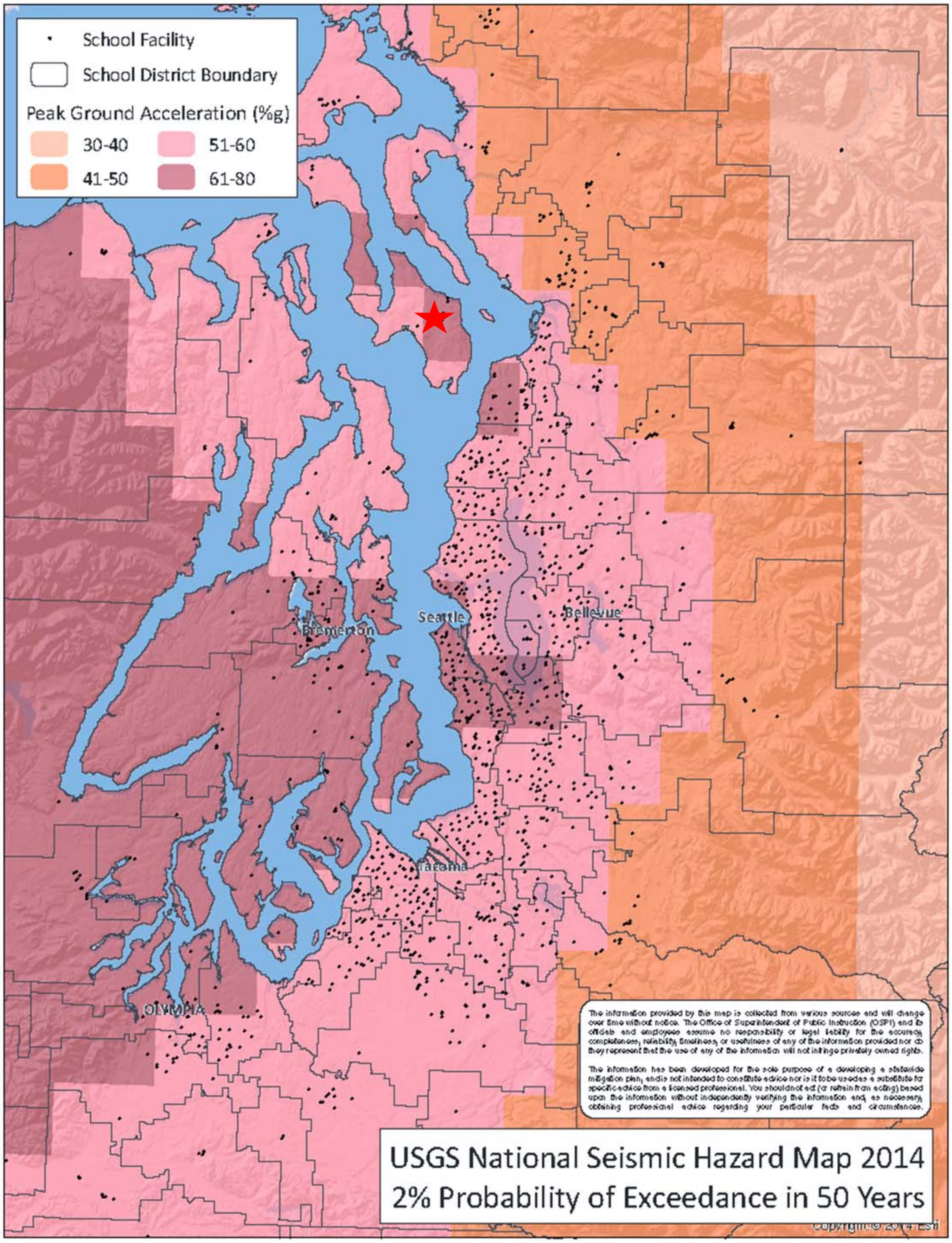
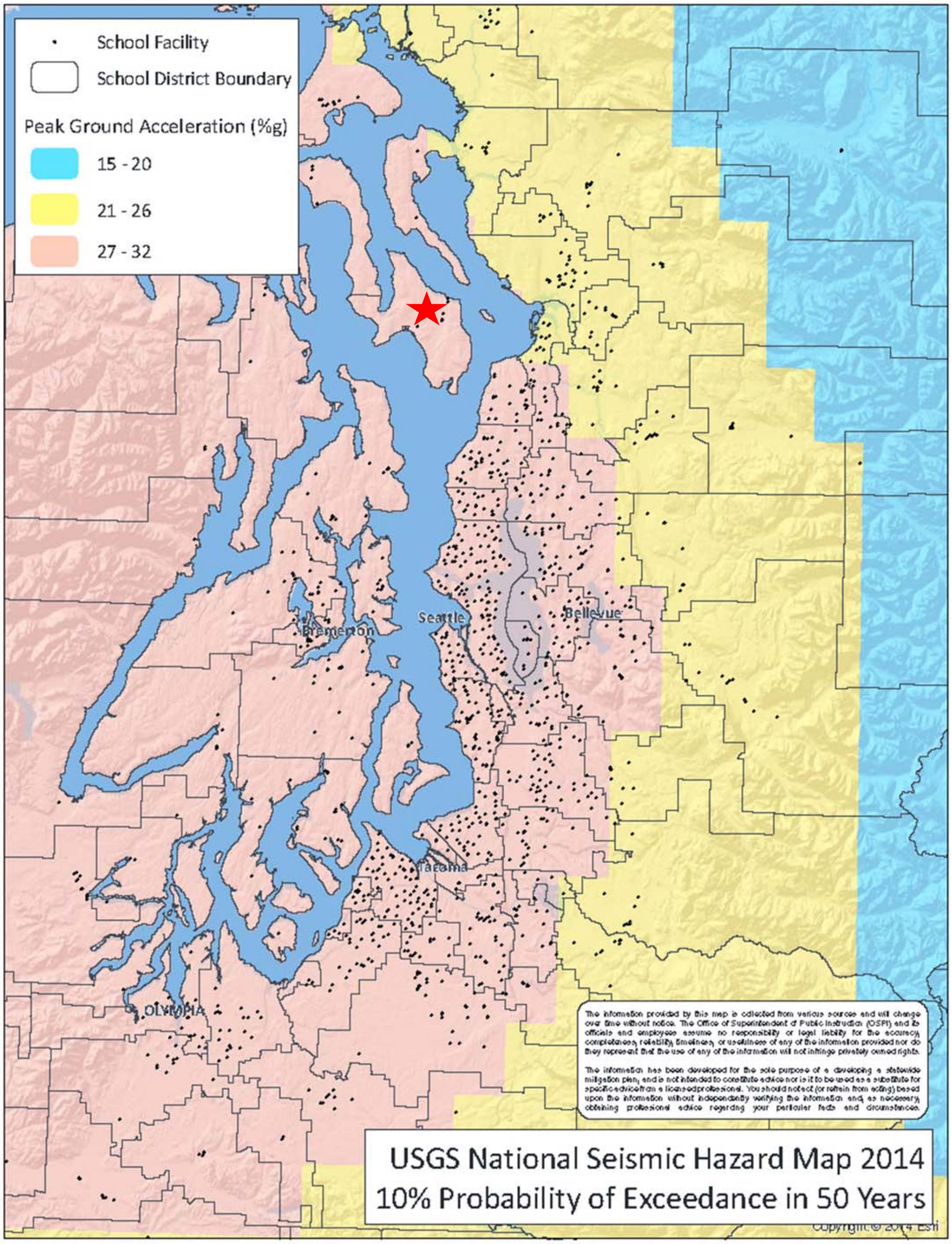


Figure 6.7
2014 USGS Seismic Hazard Map: Puget Sound Area
PGA value (percent g) with a 10% Chance of Exceedance in 50 years



6.5 Site Class: Soil and Rock Types

As discussed previously, the soil or rock type at a given location substantially affects the level of earthquake hazard because the soil or rock type may amplify or de-amplify ground motions. In general, soil sites, especially soft soil sites amplify ground motions. That is, for a given earthquake, a soil site immediately adjacent to a rock site will experience higher levels of earthquake ground motions than the rock site.

In simple terms, there are six soil or rock site classes:

- A – Hard Rock
- B – Rock
- C – Very Dense Soil and Soft Rock
- D – Firm Soil
- E – Soft Soil
- F – Very Soft Soil

Site classes for each campus in the South Whidbey School District are included in the campus-level report in Section 6.7. These estimates are from DNR or from site-specific determinations if such are entered into the OSPI ICOS PDM database.

6.6 Ground Failures and Other Aspects of Seismic Hazards

Much of the damage in earthquakes occurs from ground shaking that affects buildings and infrastructure. However, there are several other consequences of earthquakes that can result in substantially increased levels of damage in some locations. These consequences include: surface rupture; subsidence or elevation; liquefaction; settlement; lateral spreading; landslides; dam, reservoir or levee failures; tsunamis and seiches. Any of these consequences can result in very severe damage to buildings, up to and including complete destruction, and also a high likelihood of casualties.

6.6.1 Surface Rupture

Surface rupture occurs when the fault plane along which rupture occurs in an earthquake reaches the surface. Surface rupture may be horizontal and/or vertical displacement between the sides of the rupture plane. For a building subject to surface rupture the level of damage is typically very high and often results in the destruction of the building.

Surface rupture does not occur with interface or intraplate earthquakes on the Cascadia Subduction Zone and does not occur with all crustal earthquakes. Faults in Washington State where surface rupture is likely includes the Seattle Fault System and the Tacoma Fault System.

6.6.2 Subsidence

Large interface earthquakes on the Cascadia Subduction Zone are expected to result in subsidence of up to several feet or more along Washington’s Pacific Coast. For facilities located very near sea level, co-seismic subsidence may result in the facilities being below sea level or low enough so that flooding becomes very frequent. Subsidence may also impede egress by blocking some routes and thus increase the likelihood of casualties from tsunamis.

6.6.3 Liquefaction, Settlement, and Lateral Spreading

Liquefaction is a process where loose, wet sediments lose bearing strength during an earthquake and behave similar to a liquid. Once a soil liquefies, it tends to settle vertically and/or spread laterally. With even very slight slopes, liquefied soils tend to move sideways downhill (lateral spreading). Settling or lateral spreading can cause major damage to buildings and to buried infrastructure such as pipes and cables.

Estimates of liquefaction potential for each campus in the South Whidbey School District are included in the campus-level report in Section 5.7. These estimates are from DNR or from site-specific determinations, if such determinations were entered into the OSPI ICOS PDM database by the District.

6.6.4 Landslides

Earthquakes can also induce landslides, especially if an earthquake occurs during the rainy season and soils are saturated with water. The areas prone to earthquake-induced landslides are largely the same as those areas prone to landslides in general. As with all landslides, areas of steep slopes with loose rock or soils and high water tables are most prone to earthquake-induced landslides.

The South Whidbey School District has campuses with significant landslide risk. Further information about this landslide risk is included in the landslide chapter of this mitigation plan.

6.6.5 Dam, Levee and Reservoir Failures

Earthquakes can also cause failure of dams, levees and reservoirs. Campuses downslope from dams or water reservoirs or behind levees may be subject to flooding if the dams, reservoirs of levees fail as a result of an earthquake.

The South Whidbey School District has campuses with significant flood risk that include campuses downslope from dams or reservoirs or behind levees. Further information about the District's flood risk is included in the flood chapter in this mitigation plan.

6.6.6 Tsunamis and Seiches

Tsunamis most often result from earthquakes that cause a sudden rise or fall of part of the ocean floor. Tsunamis may also be generated by undersea landslides, by terrestrial landslides into bodies of water, and by asteroid impacts. However, earthquakes are the predominant cause of tsunamis.

The South Whidbey School District has communities in a Puget Sound coastal area, however no campuses are located within a mapped tsunami zone.

6.7 Seismic Risk Assessment for the South Whidbey School District's Facilities

The potential impacts of future earthquakes on the South Whidbey District include damage to buildings and contents, disruption of educational services, displacement costs for temporary quarters if some buildings have enough damage to require moving out while repairs are made, and possible deaths and injuries for people in the buildings. The magnitude of potential impacts in future earthquakes can vary enormously from none in earthquakes that are felt but result in neither damages nor casualties to very substantial for larger magnitude earthquakes with epicenters near a given campus.

The vulnerability of the South Whidbey District's facilities varies markedly from building to building, depending on each building's structural system and date of construction (which governs the seismic design provisions). The level of risk on a building by building level is summarized in the building-level earthquake risk tables later in this chapter.

The initial seismic risk assessment for the District's facilities at both the campus level and the building-level is largely automated from the data in the OSPI ICOS PDM database. The data used include GIS data for the location of each campus and district-specific data entered into the OSPI ICOS PDM database.

The three step hazard and risk assessment approach, outlined below, uses data in the OSPI ICOS PDM database for screening and prioritization of more detailed evaluations which usually require inputs from an engineer experienced with seismic assessments of buildings. The auto-generated reports help to minimize the level of effort required by districts and to reduce costs by prioritizing more detailed seismic evaluations, enabling the District to focus on the buildings most likely to have the most substantial seismic deficiencies.

The three steps include:

1. An auto-generated campus-level earthquake report that summarizes earthquake hazard data including ground shaking, site class, and liquefaction potential and classifies the combined earthquake hazard level from these data. The campus-level report also includes priorities for building-level risk assessments and geotechnical evaluations of site conditions.
2. An auto-generated building-level earthquake report that is based on the ASCE 41-13 seismic evaluation methodology. The building-level report contains the data necessary to determine whether a building is pre- or post-benchmark year for life safety. If a building is post-benchmark it is generally deemed to provide adequate life safety and no further evaluation is necessary. If not, completing an ASCE 41-13 Tier 1 evaluation is recommended. The auto-generated report includes suggested priorities for Tier 1 evaluations.
3. The third step includes completion and interpretation of the ASCE 41-13 Tier 1 evaluations and:
   a. More detailed evaluation of one or more buildings that are determined to have the highest priority for retrofit or replacement from the previous step.
   b. Design of seismic retrofits for buildings for which a retrofit is the preferred alternative.
   c. Implementation of retrofits or replacement of buildings, as funding becomes available.

The OSPI ICOS PDM database campus-level and building-level reports are shown on the following pages.

Table 6.2
Campus-Level Earthquake Report

Earthquake Campus-Level Hazard and Risk Report: Preliminary[1]									
Campus	Earthquake Ground Shaking 2% in 50 Years[2] (% g)	Site Class°	Earthquake Ground Shaking Hazard Level	Liquefaction Potential	Combined Earthquake Hazard Level	Recommendations			
						Building Level Risk Assessment		Geotechnical Evaluation	
						Yes/No[3]	Priority	Yes/No	Priority
SOUTH WHIDBEY SCHOOL DISTRICT									
Admin/Maintenance/Transportation	65.26%	G	Very High	None	Very High	Yes	Very High	No	N/A
Langley Middle School	61.50%	D-E	Very High	Low to Moderate	Very High	Yes	Very High	Yes	Moderate
Old Bayview School	59.90%	D-E	Very High	Low to Moderate	Very High	Yes	Very High	Yes	Moderate
South Whidbey Academy (Formerly S. Whidbey. Primary)	65.26%	G	Very High	None	Very High	Yes	Very High	No	N/A
South Whidbey Elementary School	65.21%	C	Very High	Very Low	Very High	Yes	Very High	No	N/A
South Whidbey High School	65.44%	C	Very High	Very Low	Very High	Yes	Very High	No	N/A

[1] Campus level risk is generally proportional to the combined earthquake hazard, but depends very strongly on the seismic vulnerability of buildings which must be evaluated at the building level. Thus, earthquake risk cannot be defined meaningfully at the campus level, except by doing building-level evaluations and then aggregating building results to provide campus-level risk.

[2] Earthquake ground motion measured as peak ground acceleration (PGA) relative to the "g", the acceleration of gravity.

[3] "Limited" applies only to campuses with low ground shaking hazard level (2% in 50 year PGA less than 20% g) and means building-level risk assessments are recommended only for the most vulnerable building types.

° The six site classes are identified as follows: A-Hard Rock, B-Rock, C-Very Dense Soil and Soft Rock, D-Firm Soil, E-Soft Soil and F-Very Soft Soil. Estimates by DNR also include intermediate classes such as D-E, where the data is not sufficient to distinguish between D and E, as well as G-Unknown, when data is missing

DISCLAIMER: The information provided in this report is collected from various sources and may change over time without notice. The Office of Superintendent of Public Instruction (OSPI) and its officials and employees take no responsibility or legal liability for the accuracy, completeness, reliability, timeliness, or usefulness of any of the information provided.
The information has been developed and presented for the sole purpose of developing school district mitigation plans and to assist in determining where to focus resources for additional evaluations of natural hazard risks. The reports are not intended to constitute in-depth analysis or advice, nor are they to be used as a substitute for specific advice obtained from a licensed professional regarding the particular facts and circumstances of the natural hazard risks to a particular campus or building.

Table 6.3
Building-Level Earthquake Report (Note: 31-03 process used)

South Whidbey Building-Level Earthquake Report														
	Seismic Design Criteria						ASCE 41-13 Tier 1 Evaluation Recommended[1]		ASCE 41-13 Tier 1 Evaluation[a]					
Building-Area	**Year Built**	**UBC or IBC**	**Code Year**	**Post-Benchmark (yes/no)**	**Building Type**	**Seismic Design Basis Code**	**Yes/ No**	**Risk Level and Priority[2,3]**	**Complete (yes/no)**	**ASCE 41-13 Compliant (yes/no)**	**Further Eval Desired**	**Mitigation Desired (yes/no)**	**Mitigation Type**	**Mitigation Complete (yes/no)**
Langley Middle School Facility														
A - Main Building - A Classroom	1941			N	W1	Pre	Y	Moderate	Y	N	N	Y	Combined Retrofit	N
B - Library Building - B - Library	1935			N	W1	Pre	Y	Moderate	Y	N	N	Y	Combined Retrofit	N
C - Auditorium Building - C - Auditorium	1960			N	W1	Low	Y	Low to Moderate	Y	N	N	Y	Combined Retrofit	N
D - Spencer Building - D - Spencer	1954			N	W1	Low	Y	Low to Moderate	Y	N	N	Y		N
E - Gymnasium/ Cafeteria - E - Gymnasium/ Cafeteria	1949			N	C2L	Low	Y	Moderate to High	Y	N	N	N		N
F - Cooler building - Cooler Building	1962			N	RM1L	Low	Y	High	Y	N	N	Y	Combined Retrofit	N
G - Gymnasium Addition - G - Gym Addition	1995			N	RM1L	Moderate	Y	Moderate to High	Y	Y	N	N		N

South Whidbey Building-Level Earthquake Report															
	Seismic Design Criteria						ASCE 41-13 Tier 1 Evaluation Recommended[1]		ASCE 41-13 Tier 1 Evaluation[a]						
Building-Area	Year Built	UBC or IBC	Code Year	Post-Benchmark (yes/no)	Building Type	Seismic Design Basis Code	Yes/ No	Risk Level and Priority[2,3]	Complete (yes/no)	ASCE 41-13 Compliant (yes/no)	Further Eval Desired	Mitigation Desired (yes/no)	Mitigation Type	Mitigation Complete (yes/no)
Greenhouse Building - Greenhouse	1989					Moderate		Missing Data	N	N	N	N		N
H - Spencer Building Addition - Spencer Addition	1995			Y	W1	Moderate	N	Low	Y	Y	N	N		N
Storage Building - Storage	1980			N	S2L	Moderate	Y	Moderate	N	N	N	N		N
Old Administration Building - Old Admin Bldg.	1985			Y	W1	Moderate	N	Low	N	N	N	N		N

Table 6.3
Building-Level Earthquake Report Cont.
(Note: 31-03 process used)

South Whidbey Building-Level Earthquake Report															
	Seismic Design Criteria						**ASCE 41-13 Tier 1 Evaluation Recommended**[1]		**ASCE 41-13 Tier 1 Evaluation**[a]						
Building-Area	**Year Built**	**UBC or IBC**	**Code Year**	**Post-Benchmark (yes/no)**	**Building Type**	**Seismic Design Basis Code**	**Yes/ No**	**Risk Level and Priority**[2,3]	**Complete (yes/no)**	**ASCE 41-13 Compliant (yes/no)**	**Further Eval Desired**	**Mitigation Desired (yes/no)**	**Mitigation Type**	**Mitigation Complete (yes/no)**
Old Bayview School Facility														
Main Building - Bayview	1895			N	W1	Pre	Y	Moderate	N	N	N	N		N
South Whidbey Academy (Formerly S. Whidbey. Primary) Facility														
A- Classrooms - A - Classroom	1969			N	S5L	Low	Y	Moderate to High	Y	N	N	Y	Combined Retrofit	N
B - Play shed - B - Play shed	1969			N	S5L	Low	Y	High	Y	N	N	N	Structural Retrofit	Y
C - Classrooms/Admin - C - Classrooms/Admin	1969			N	S5L	Low	Y	Moderate to High	Y	N	N	Y	Combined Retrofit	N
D - WIA Office/Classrooms - WIA	1969			N	S5L	Low	Y	Moderate to High	Y	N	N	Y	Combined Retrofit	N
E - Classrooms - E - Classrooms	1969			N	S5L	Low	Y	Moderate to High	Y	N	N	Y	Combined Retrofit	N
F - Multipurpose -	1969			N	S5L	Low	Y	Moderate	Y	N	N	Y	Combined	N

South Whidbey Building-Level Earthquake Report														
	Seismic Design Criteria						ASCE 41-13 Tier 1 Evaluation Recommended[1]		ASCE 41-13 Tier 1 Evaluation[a]					
Building-Area	**Year Built**	**UBC or IBC**	**Code Year**	**Post-Benchmark (yes/no)**	**Building Type**	**Seismic Design Basis Code**	**Yes/ No**	**Risk Level and Priority[2,3]**	**Complete (yes/no)**	**ASCE 41-13 Compliant (yes/no)**	**Further Eval Desired**	**Mitigation Desired (yes/no)**	**Mitigation Type**	**Mitigation Complete (yes/no)**
F - Multipurpose								to High					Retrofit	
- Stage Addition	1996			N	RM1L	Moderate	Y	High	Y	N	N	Y	Combined Retrofit	N
G - Library/Board Room - Library/Board Room	1996				W1	Moderate		Missing Data	Y	N	N	Y	Combined Retrofit	N
Portable P-1 - Portable P-1	1989				W1	Moderate		Missing Data	N	N	N	N		N
Portable P-2 - Portable P-2	1989				W1	Moderate		Missing Data	N	N	N	N		N
Preschool portable - Preschool	1989				W1	Moderate		Missing Data	N	N	N	N		N

Table 6.3
Building-Level Earthquake Report Cont.
(Note: 31-03 process used)

South Whidbey Building-Level Earthquake Report														
	Seismic Design Criteria						ASCE 41-13 Tier 1 Evaluation Recommended[1]		ASCE 41-13 Tier 1 Evaluation[a]					
Building-Area	Year Built	UBC or IBC	Code Year	Post-Benchmark (yes/no)	Building Type	Seismic Design Basis Code	Yes/ No	Risk Level and Priority[2,3]	Complete (yes/no)	ASCE 41-13 Compliant (yes/no)	Further Eval Desired	Mitigation Desired (yes/no)	Mitigation Type	Mitigation Complete (yes/no)
South Whidbey Elementary School Facility														
Main Building - Main Building	1988			Y	W2	Moderate	N	Low	N	N	Y	N		N
North Covered Play - covered play	1988							Missing Data						
South Covered Play - south covered play	1988							Missing Data						
Head Start Portable - Head Start Portable	2000			Y	W1	High	N	Low	N	N	N	N		N
Preschool Portable - Preschool Portable	2000			Y	W1	High	N	Low	N	N	N	N		N
South Whidbey High School Facility														
1997 Addition - Area 1	1997			N	S2L	Moderate	Y	Moderate to High	N	N	Y	N		N

South Whidbey Building-Level Earthquake Report															
	Seismic Design Criteria						ASCE 41-13 Tier 1 Evaluation Recommended[1]		ASCE 41-13 Tier 1 Evaluation[a]						
Building-Area	Year Built	UBC or IBC	Code Year	Post-Benchmark (yes/no)	Building Type	Seismic Design Basis Code	Yes/ No	Risk Level and Priority[2,3]	Complete (yes/no)	ASCE 41-13 Compliant (yes/no)	Further Eval Desired	Mitigation Desired (yes/no)	Mitigation Type	Mitigation Complete (yes/no)
Concession Stand - Concessions	1988			Y	W1	Moderate	N	Low	N	N	N	N		N
Main Building - Main Building	1989			N	S2L	Moderate	Y	Moderate to High	N	N	Y	N		N
Stadium Grandstand - Grandstands	1989			N	S3	Moderate	Y	Moderate to High	N	N	Y	N		N
Portables - Portable 1	2000			Y	W1	High	N	Low						
- Portable 2	2000			Y	W1	High	N	Low						
- Portable 3	2000			Y	W1	High	N	Low	N	N	N	N		N

Table 6.3
Building-Level Earthquake Report (Note: 31-03 process used)

South Whidbey Building-Level Earthquake Report															
Building-Area	Seismic Design Criteria				Building Type	Seismic Design Basis Code	ASCE 41-13 Tier 1 Evaluation Recommended[1]		ASCE 41-13 Tier 1 Evaluation[a]			Mitigation Desired (yes/no)	Mitigation Type	Mitigation Complete (yes/no)
	Year Built	UBC or IBC	Code Year	Post-Benchmark (yes/no)			Yes/ No	Risk Level and Priority[2,3]	Complete (yes/no)	ASCE 41-13 Compliant (yes/no)	Further Eval Desired			
Admin/Maintenance/Transportation Facility														
Bus Wash - Bus Wash	2000			N	S3	High	Y	Moderate	N		N	N		N
Fueling Station - Fueling Station	2000			Y	S2L	High	N	Low	N	N	N	N		N
Main Building - Admin	2000			Y	S2L	High	N	Low	N	N	N	N		N

[1] ASCE 41-13 seismic evaluations are recommended for buildings that were not designed to a "benchmark" seismic code deemed adequate to provide life safety. However, ASCE 41-13 recommends that post-benchmark code buildings be evaluated by an engineer to verify that the as-built seismic details conform to the design drawings. Most such buildings should be compliant, unless poor construction quality degrades the expected seismic performance of the building.

[2] The priority for 41-13 evaluations is based on the building type, the combined earthquake hazard level (ground shaking and liquefaction potential), the seismic design basis, and whether a building has been identified as having substantial vertical or horizontal irregularities. These priorities recognize that many districts have limited funding for 41-13 evaluations. Districts with adequate funding may wish to complete 41-13 evaluations on all pre-benchmark year buildings.

[3] The earthquake risk level is low for all buildings for which an ASCE 41-13 evaluation is not recommended as necessary. For other buildings, the preliminary risk level and the priority for 41-13 evaluation are based on the earthquake hazard level, the building structural type, the seismic design level and whether a building has vertical and horizontal irregularities.

[a] The final determination of priorities for retrofit are based on whether a building is compliant with the 41-13 life safety criteria. If not, the priorities should be set in close consultation with the engineer who completed the 41-13 evaluation.

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The earthquake hazard level across the District is very high as result of the intensity of ground shaking expected. The liquefaction risk across the district varies from none to low/moderate for Bayview Elementary and Langley Elementary school that have softer soils (site class D-E). Upon a more detailed review of the buildings there are only are three buildings at high risk: the cooler building and gym at Langley Middle School and the multi-purpose building at the South Whidbey Academy. There are number of other buildings throughout the district had moderate to high risk. As a whole most of the buildings in the district are at low to moderate risk from earthquakes.

6.8 Previous Earthquake Events

The District did experience ground shaking during the February 28, 2001 Nisqually Magnitude 6.8 earthquake. District maintenance staff found cracked plaster at a number of campuses that was later repaired. No other damage was observed at any of the campuses.

6.9 Earthquake Hazard Mitigation Measures for K–12 Facilities

6.9.1 Typical Seismic Mitigation Measures

There are several possible earthquake mitigation Action Items for the District's facilities, including:

- Replacement of seismically vulnerable buildings with new buildings that meet or exceed the seismic provisions in the current building code,
- Structural retrofits for buildings,
- Nonstructural retrofits for buildings and contents,
- Installation of emergency generators for buildings with critical functions, including designated emergency shelters, and
- Enhanced emergency planning, including earthquake exercises and drills.

Of these potential earthquake Action Items, FEMA mitigation grants, which typically provide 75% of total project costs, may be available for structural or nonstructural retrofits and for emergency generators.

Earthquake Action Items for the South Whidbey School District are given in Table 6.4 on the following page.

Table 6.4
South Whidbey School District: Earthquake Action Items

Hazard	Action Item	Timeline	Source of Funds	Responsible Party	Plan Goals Addressed			
					Life Safety	Protect Facilities	Enhance Emergency Planning	Enhance Awareness and Education
Earthquake Mitigation Action Items								
Short-Term #1	Complete a life safety seismic retrofit for the North Gym at LMS, as funding becomes available	1-2 Years	District or Grants	Supt.	X	X		
Short-Term #2	Evaluate the seismic vulnerability of the 1950s portions of the Elementary and Middle Schools by having a structural engineer complete an ASCE 41-13 Tier 1 evaluation.	1-2 Years	District or Grants	Supt	X	X		X
Short-Term #3	Have a structural engineer review the drawings of the remodel of the High School to verify that necessary structural seismic mitigation measures were included. If not, complete an ASCE 41-13 Tier 1 evaluation.	1-2 Years	District or Grants	Supt	X	X		X
Short-Term #4	Assess the ASCE 41-13 results and select buildings or building parts that have the greatest vulnerability for more detailed evaluations.	1-3 Years	District or Grants	Supt	X	X		X
Short-Term #5	Evaluate the foundations of the portable buildings to determine whether they are adequate for earthquakes.	1-3 Years	District or Grants	Supt	X	X		X
Short-Term #6	Complete a life safety retrofit for the Primary Campus, as funding becomes available.	1-3 Years	District or Grants	Supt	X	X		
Short-Term #7	Anchor bolting of wood sill plates to the foundation at Langley Middle School	1-3 Years	District or Grants	Supt	X	X		
Long-Term #1	Prioritize and implement seismic retrofits or replacements based on the results of the detailed evaluations, as funding becomes available.	Ongoing	District or Grants	Supt	X	X		X
Long-Term #2	Maintain and update building data for seismic risk assessments in the OSPI ICOS PDM database.	Ongoing	District or Grants	Supt	X	X		X
Long-Term #3	Enhance emergency planning for earthquakes including duck and cover and evacuation drills.	Ongoing	District or Grants	Supt	X		X	X

6.10 References

1. United States Geological Survey (2013). Largest Earthquakes in the World Since 1900.

http://earthquake.usgs.gov/earthquakes/world/10_largest_world.php

2. University of Washington (2002). Map and List of Significant Quakes in WA and OR, The Pacific Northwest Seismograph Network. University of Washington Department of Earth Sciences.

3. Washington State Department of Natural Resources (2013).

https://fortress.wa.gov/geology?Theme-wigm

4. Cascadia Region Earthquake Working Group (2005): Cascadia Subduction Zone Earthquakes: A Magnitude 9.0 Earthquake Scenario.

5. Oregon Seismic Safety Policy Advisory Commission (2013). The Oregon Resilience Plan.

6. Washington State Department of Natural Resources (2004). Liquefaction Susceptibility and Site Class Maps of Grays Harbor County, Washington. Open File Report 2004-20.

7.0 WILDLAND/URBAN INTERFACE FIRES

7.1 Overview

Fire has posed a threat to mankind since the dawn of civilization. Fires often cause substantial damage to property and may also result in deaths and injuries.

For the purposes of mitigation planning, we define three types of fires:

- Structure fires and other localized fires,
- Wildland fires, and
- Wildland/urban interface fires.

Structure fires are fires where structures and contents are the primary fuel. In dealing with structure fires, fire departments typically have three primary objectives: 1) minimize casualties, 2) prevent a structure fire from spreading to other structures, and 3) minimize damage to the structure and contents. Structure fires and the other common types of fires, such as vehicle or trash fires are most often limited to a single structure or location, although in some cases they may spread to adjacent structures.

Wildland fires are fires where vegetation (grass, brush, trees) is the primary fire fuel and with few or no structures involved. For wildland fires, the most common suppression strategy is to contain the fire at its boundaries and then to let the fire burn itself out. Fire containment typically relies heavily on natural or manmade fire breaks. Water and chemical fire suppressants are used primarily to help make or defend a fire break, rather than to put out an entire fire, as would be the case with a structure fire. For wildland fires, fire suppression responsibility is generally with state and federal fire agencies, although local agencies may also participate.

Wildland/urban interface fires are fires where the fire fuel includes both structures and vegetation. The defining characteristic of the wildland/urban interface area is that structures are built in or immediately adjacent to areas with essentially continuous vegetative fuel loads. When wildland fires occur in such areas, they often spread quickly and structures in these areas may, unfortunately, simply become additional fuel sources. Fire suppression efforts for wildland/urban interface fires focus first on savings lives and then on protecting structures to the extent possible. Local fire agencies have primary fire suppression responsibility for most wildland/urban interface fires, although state and federal agencies may also contribute.

This chapter focuses on wildland/urban interface fires that pose a substantial threat to districts with K–12 facilities in locations subject to wildland/urban interface fires.

7.2 Wildland/Urban Interface Fires

Many urban or suburban areas have a significant amount of landscaping and other vegetation. However, in most areas the fuel load of flammable vegetation is not continuous, but rather is broken by paved areas, open space and areas of mowed grassy areas with low fuel loads. In these areas, most fires are single structure fires. The combination of separations between buildings, fire breaks, and generally low total vegetative fuel loads make the risk of fire spreading much lower than in wildland areas.

Furthermore, most developed areas in urban and suburban areas have water systems with good capacities to provide water for fire suppression and fire departments that respond quickly to fires, with sufficient personnel and apparatus to control fires effectively. Thus, the likelihood of a single structure fire spreading to involve multiple structures is generally quite low.

Areas subject to wildland/urban interface fires have very different fire hazard characteristics which are more similar to those for wildland fires. The level of fire hazard for wildland/urban interface fires depends on:

- Vegetative fuel load,
- Topography,
- Climate and weather conditions,
- Ignition sources and frequency of fire ignitions, and
- Fire suppression resources (fire agency response time and resources of crews and apparatus, access and water supplies).

High vegetative fuel loads, especially brush and trees, increase the level of wildland/urban fire hazard. Steep topography increases the level of fire risk by exacerbating fire spread and impeding fire suppression efforts by making access more difficult.

The level of fire hazard in areas prone to wildland/urban interface fires is also substantially increased when weather conditions including high temperatures, low humidity, and high winds greatly accelerate the spread of wildland fires and make containment difficult or impossible.

Fire suppression resources are typically much lower in wildland/urban interface fire areas than in more highly developed areas. Fire stations are more widely spaced, with fewer resources of crews and apparatus and longer response times because of distance and/or limited access routes. Water resources for fire suppression are typically lower in these areas, which are often predominantly residential and may be served by pumped pressure zones with limited water storage or by individual wells which provide no significant water supply for fire suppression.

These reduced fire suppression resources make it more likely that a small wildland fire or a single structure fire in an urban/wildland interface area will spread before it can be extinguished.

The level of risk from wildland/urban interface fires for K–12 facilities depends on:

- Level of fire hazard as outlined above,
- Value and importance of buildings and infrastructure,
- Vulnerability of inventory at risk, including whether fire-safe construction practices and defensible space measures have been implemented, and
- Population at risk and the efficacy of evacuations.

Life safety risk in wildland/urban interface fires arises in large part from delays in evacuations, once a fire has started. For K–12 facilities with significant risk from wildland/urban interface fires, a well-defined, practical and practiced evacuation plan is essential to minimize potential life safety risk.

7.3 Wildland and Wildland/Urban Fire Hazard Mapping and Hazard Assessment

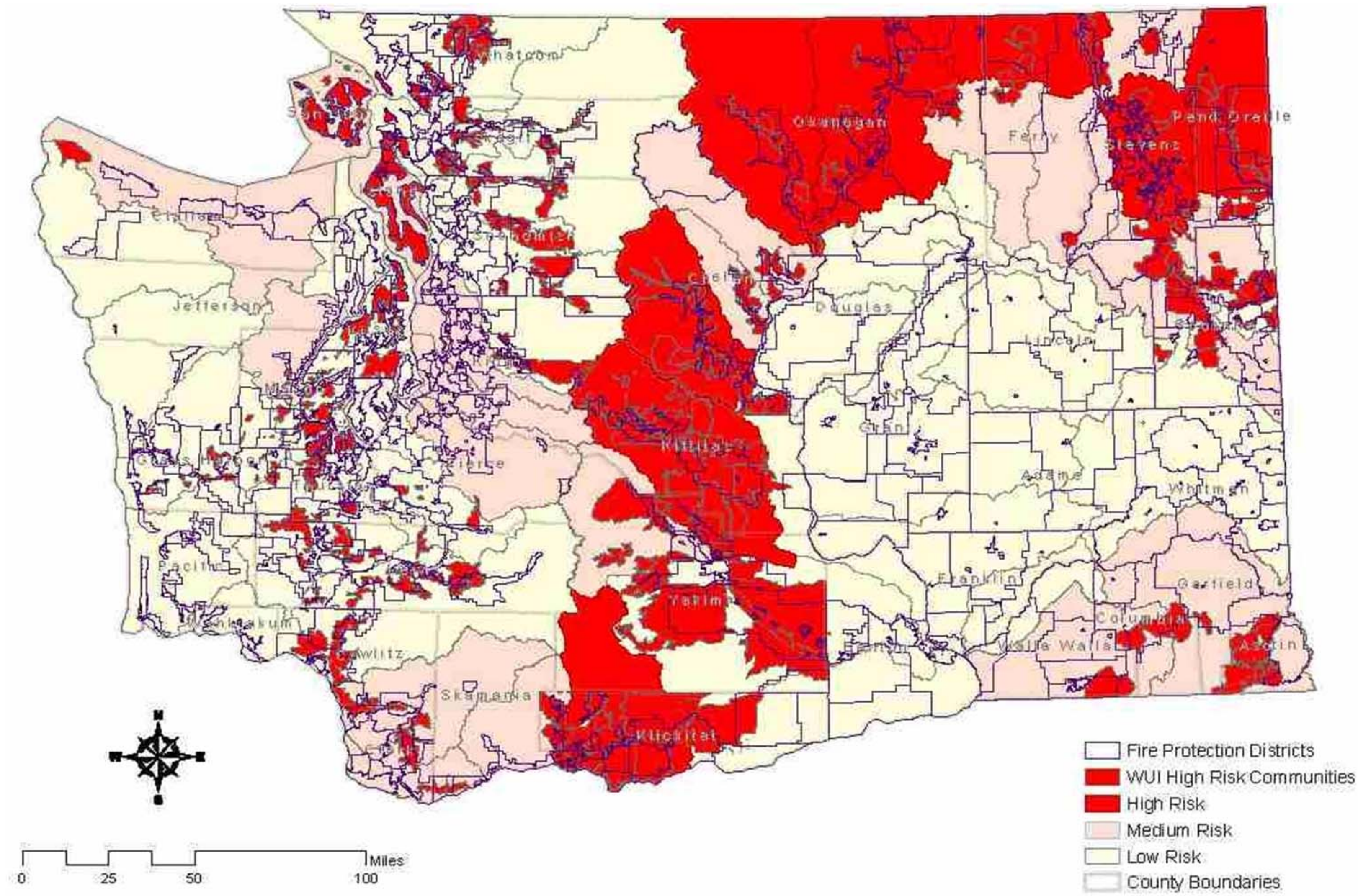
The three maps on the following pages present different measures of wildland and wildland/urban interface fire hazards in Washington. There are important caveats regarding these maps when making wildland/urban interface fire mitigation decisions for K–12 facilities within mapped fire hazard areas:

- The DNR rankings of Wildland/Urban Interface Communities of extreme, high, moderate or low risk should be interpreted as qualitative or semi-quantitative indicators of the relative level of risk. Facilities identified as being located in communities with "extreme" or "high" levels of risk may not have extreme or high risk as generally understood for mitigation planning purposes. Some of the extreme or high risk interface communities have long burn return periods (the average time interval between fire events) per the USGS Landfire map.
- The USGS Landfire Return Period values should also be interpreted as semi-quantitative indicators of the relative level of risk. The numerical estimates of the burn return period and the corresponding probabilities over a 50-year time period should not be interpreted literally.

The DNR rankings and the USGS Landfire Return Periods are based on analysis of fire regime characteristics – such as vegetative fuel loads, topography, climate and fire suppression resources. The USGS Landfire Return Periods may indicate higher levels of fire risk than suggested by historical fire data. Furthermore, most of the acreage burned has been wildland with relatively few structures and very few, if any, K–12 facilities.

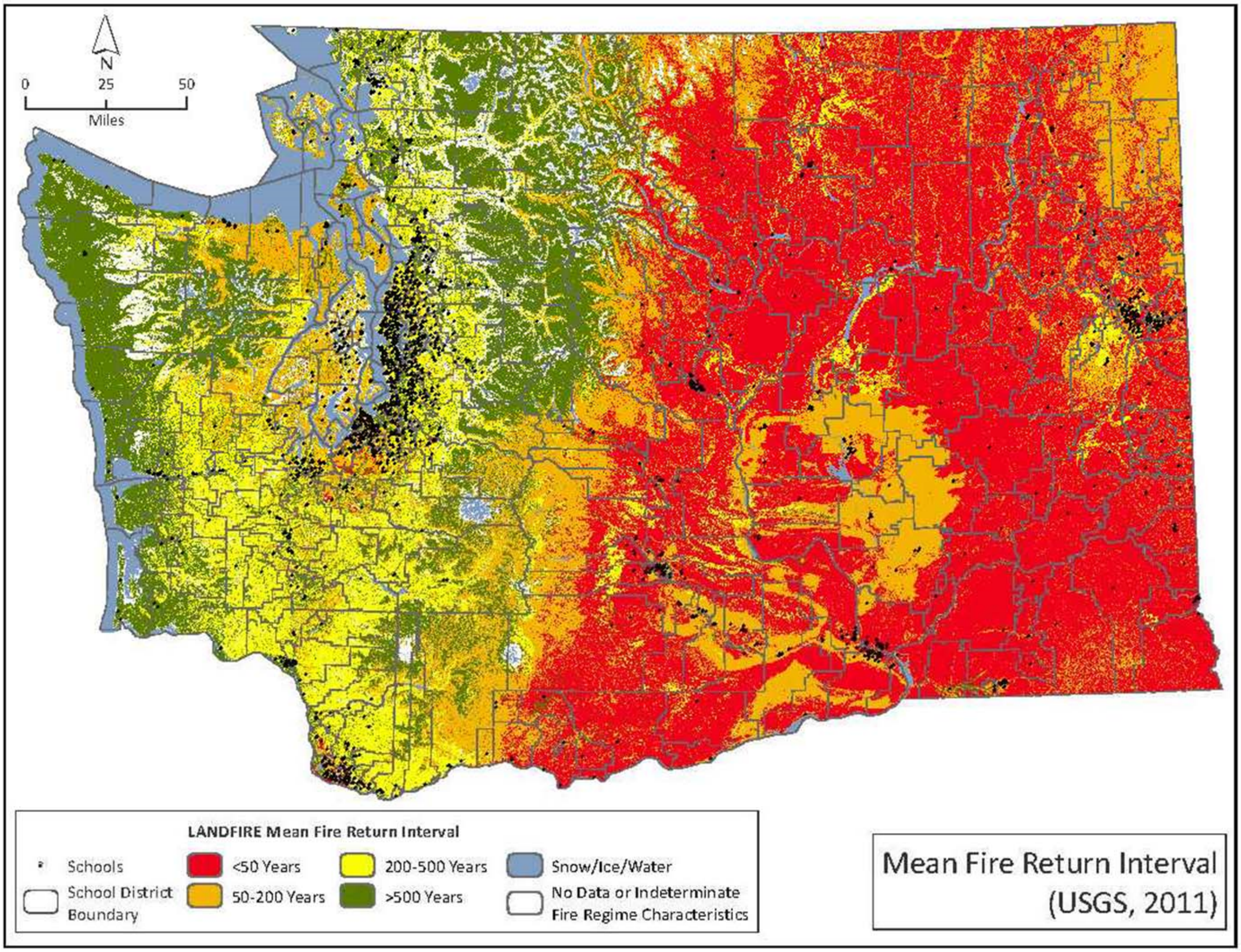
Figure 7.1
Wildland/Urban Interface Communities Identified by Washington Department of Natural Resources

Figure 7.2
Washington Wildland/Urban Interface High Risk Communities and Statewide Assessment High and Moderate Risk Areas



[1]Washington State Department of Natural Resources, Fire Risk Map, 2010.

Figure 7.3
United States Geological Survey Landfire Fire Return Period Map



7.4 Wildland/Urban Interface Fire Hazard and Risk Assessments

The potential impacts of future wildland/urban interface fires on the South Whidbey District are primarily damage to buildings and contents (include possible complete destruction), disruption of educational services, and displacement costs for temporary quarters if some buildings have enough damage to require moving out while repairs are made. The likelihood of deaths or injuries is generally low, because schools will be evacuated whenever fire warnings are issued. However, in events where evacuation is not timely, there may a substantial risk of deaths and injuries.

The vulnerability of the South Whidbey District's facilities to wildland/urban interface fires varies from campus to campus. The approximate levels of wildland/urban interface fire hazards and vulnerability are identified at the campus level in the following sections.

There have been no historical wildland/urban interface fires that directly affected or came very close to any of the district's campuses.

The campus-level wildland/urban interface fire hazard and risk report for the South Whidbey School District is shown on the following page. The fire hazard and risk levels are generated within the OSPI ICOS Pre-Disaster Mitigation database, by combining the DNR Wildland Interface Community rankings, the Landfire fire return periods and the campus-specific information entered into the database.

For campuses where the hazard and risk level is moderate or higher, the recommendation is to consult with the local fire agency regarding the level of risk at each campus and to determine whether fire mitigation measures may be appropriate. However, regardless of risk levels, all campuses in a wildland/urban interface should have evacuation plans for wildland/urban interface fire events.

More accurate evaluation of wildland/urban interface fire risk for a campus or a building starts with the fire hazard factors listed previously, but also requires higher-resolution, campus-level and building-level information, including:

- Vegetative fuel loads on, adjacent and near the campus, including fuel types, fuel density, and proximity of high fuel load areas to the campus,
- Extent to which campus buildings have fire-safe construction details and defensible space.
- The number of available evacuation routes and the effectiveness of evacuation plans.

Locations with only one or two evacuation routes, which might be blocked by a given fire event, have much higher life safety risk than locations with multiple possible evacuation routes. Evaluation of the above characteristics may require technical advice and support from fire professionals, including local fire agency staff or other fire experts. Such professional advice is beneficial for any campus in a wildland/urban interface.

Building-level risk assessment reports for wildland/urban interface fires are shown on the pages following the campus-level report.

Table 7.1
South Whidbey School District Campus Level Wildland/Urban Interface Hazard and Risk Assessment Report

dland and Urban Interface (Fire) Campus-Level Hazard and Risk Report							Recommendat
Campus	WUI Community DNR Rating	USGS Landfire Return Period Range[1] (Years)	High Fuel Load Areas Near Campus[2]	History of WUI Fires Affecting or Near Campus	Fire Agency Concern about WUI Fires	WUI Hazard Level and Preliminary Risk Level[3]	Consult wit Local Fire Age About Risk a Mitigation
TH WHIDBEY SCHOOL DISTRICT							
in/Maintenance/Transportation	Not Applicable	NA	Yes	No	No	Moderate	Yes
iew Alternative School	Moderate	501-1000	Yes	No	No	High	Yes
ley Middle School	Moderate	71-80	Yes	No	No	High	Yes
n Whidbey Academy	Not Applicable	501-1000	Yes	No	No	Moderate	Yes
n Whidbey Elementary School	Moderate	71-80	Yes	No	No	High	Yes
n Whidbey High School	Moderate	71-80	Yes	No	No	High	Yes

GS Landfire estimates of fire return periods have very short returns for many locations, with correspondingly high probabilities in 50 years. Historical fire data suggest lo n periods and lower probabilities. These estimates are best interpreted as indicating relative fire risk, not absolute fire risk.

thin 0.5 mile.

e WUI preliminary risk level characterized as the same as WUI hazard level. Building-level assessments required to determine risk more accurately.

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nformation has been developed and presented for the sole purpose of developing school district mitigation plans and to assist in determining where to focus resources tional evaluations of natural hazard risks. The reports are not intended to constitute in-depth analysis or advice, nor are they to be used as a substitute for specific advic ined from a licensed professional regarding the particular facts and circumstances of the natural hazard risks to a particular campus or building.

7.5 Mitigation for Wildland/Urban Interface Fires

Common goals for reducing wildland/urban interface fire risk include:

1) Reduce the probability of fire ignitions,

2) Reduce the probability that small fires will spread,

3) Minimize life safety risk, and

4) Minimize property damage.

School districts are not responsible for fire suppression or community-wide mitigation measures for wildland/urban interface fires, which are the responsibility of cities, counties and fire agencies.

For districts with campuses determined to be at significant risk from wildland/urban interface fires, there are three types of practical mitigation measures:

- For life safety, develop and practice effective evacuation plans for wildland/urban interface fires,
- For existing facilities with significant risk:
  - Maintain the maximum possible defensible space around buildings and reduce vegetative fuel loads adjacent to a campus,
  - Implement fire-safe improvements such as non-flammable roofs, covering vent openings and overhangs with wire mesh to prevent entry and trapping of embers and others, and
- Whenever possible, site new facilities outside of areas with high risk of wildland/urban interface fires, include fire-safe features in the design and ensure the maximum possible defensible space around new buildings.

Some types of mitigation projects for wildland/urban interface fire may be eligible for FEMA and other grant funding, including:

- Defensible space activities,
- Hazardous fuel reduction activities, and
- Ignition resistant construction activities.

For existing buildings, implementing many ignition resistant building upgrades may be most cost-effective when done incrementally. For example, replacing an old roof covering with a non-flammable roof covering may be done at the time the existing roof has reached the end of its useful life and is scheduled for replacement.

The South Whidbey School Districts' mitigation Action Items for wildland/urban interface fires are shown in the table on the following page.

Table 7.3

South Whidbey School District: Wildland/Urban Interface Fire Mitigation Action Items

Hazard	Action Item	Timeline	Source of Funds	Responsible Party	Plan Goals Addressed: Life Safety	Plan Goals Addressed: Protect Facilities	Plan Goals Addressed: Enhance Emergency Planning	Plan Goals Addressed: Enhance Awareness and Education
Wildland/Urban Interface Fire Mitigation Action Items								
Short-Term #1	Consult with Fire District #3 regarding level of fire risk for campuses for which this is recommended by the OSPI ICOS PDM database campus-level wildland/urban interface fire report.	1-2 Years	District or Grants	Supt	X	X	X	X
Short-Term #2	Enhance emergency evacuation planning for all campuses for which wildland/urban fires are possible.	1 year	District or Grants	Supt	X		X	X
Long-Term #1	Review defensible space around district facilities and implement mitigation measures to reduce fire risk, increase defensible space, and reduce potential fuel sources.	1-2 Years	District or Grants	Supt	X	X		

8.0 OTHER NATURAL HAZARDS

Previous chapters have addressed the natural hazards which pose the greatest risks for the South Whidbey School District's facilities and people. In addition to these hazards, there are other natural hazards which pose less risk to the District. This chapter addresses these other natural hazards.

8.1 Flood

Flood risk exists at a low level at two sites, Bayview School and Langley Middle School. both reside within 0.5 miles of a FEMA flood zone. Both sites are at good elevations and have no flood events recorded in the past 20 years. Apart from storm water management, no action items are planned for this hazard.

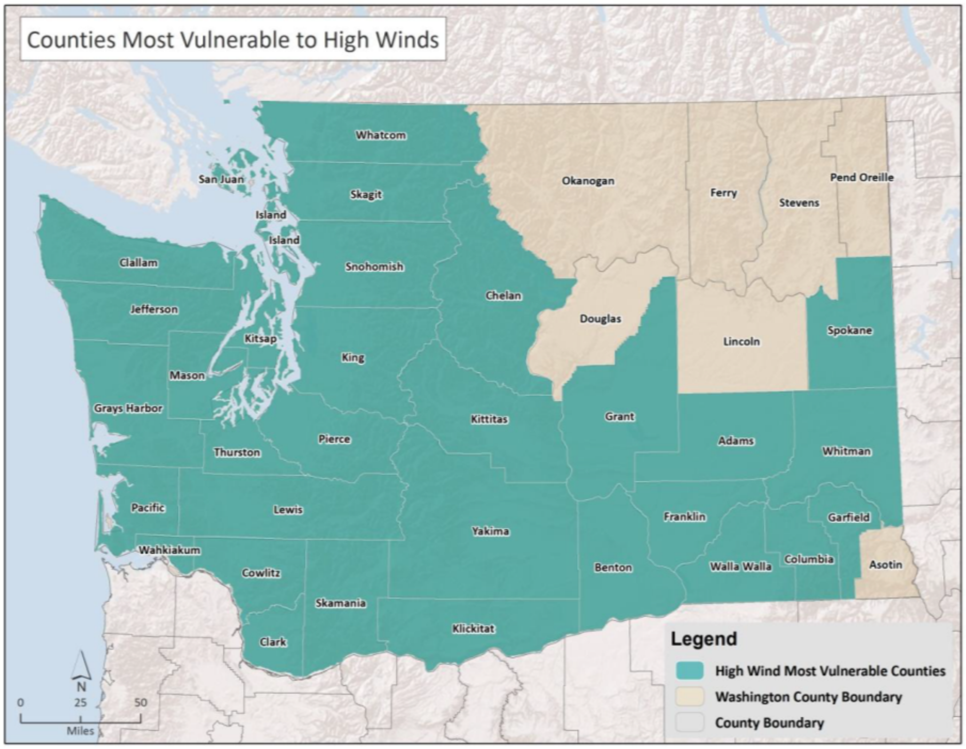
8.2 Severe Weather

Severe weather events are possible throughout Washington State, including: high winds, snow storms, ice storms, thunderstorms, hail and tornadoes. Most such events have relatively minor impacts on K–12 facilities although more severe events may result in significant damages. Of these types of weather hazards, high winds pose the greatest risk to K–12 facilities, although the level of risk for most facilities is much lower than for facilities at high risk from the major hazards addressed in previous chapters.

High Winds

High wind events can occur anywhere in Washington, but the most severe events have occurred on the Pacific Coast and in the Cascades. The following map (Figure 7.1) from the 2013 Washington State Enhanced Hazard Mitigation plan shows that nearly all counties in the state are deemed at significant risk from high wind events.

Figure 8.1
Counties Most Vulnerable to High Winds[1]



The most common impacts from high wind events are loss of electric power from downed overhead power lines due to tree falls or from direct wind forces on power lines. Damage to buildings can range from limited roof damage to major structural damage from wind or from tree falls onto buildings.

More severe events such as the 1962 Columbus Day windstorm result in more widespread damage to vulnerable buildings. Most K–12 facilities will suffer little or no damage in minor to moderate windstorms, with higher levels of damage mostly limited to very severe wind events, especially for the most vulnerable buildings, such as portables, that are not adequately tied down.

Snow and Ice Storms

Numerous snow and ice storms occur in Washington State every year. The principal impacts from severe storms are disruption of electric power from downed overhead lines and disruption of transportation. Severe snow or ice storms result in school closures but rarely result in significant damage to school facilities.

In severe storms, with unusually heavy loading of snow and/or ice, a few very vulnerable buildings may collapse. Most school buildings have been designed for snow loads and thus are unlikely to suffer significant damage except for extreme events with snow and/or ice loads well above the design loads. Districts with older buildings, especially large span buildings, in areas with high annual snowfalls may wish to evaluate some buildings for the capacity to withstand snow and ice loads on the roofs.

Thunderstorms and Hail Storms

Thunderstorms and hail storms occur fairly frequently in Washington State, although the frequency and severity of such events is much lower than in many parts of the United States. Severe thunderstorms may have high enough winds to result in downed overhead electric lines and tree falls with disruptions to utilities and transportation. However, the likelihood of thunderstorms severe enough to result in significant damage to K–12 facilities appears very low.

Hail storms may occur anywhere in Washington but are more common in eastern Washington. Hail storms with large diameter hail may cause significant damage to exposed vehicles and localized damage to some roofs. However, the likelihood of hail storms severe enough to result in significant damage to K–12 facilities appears extremely low.

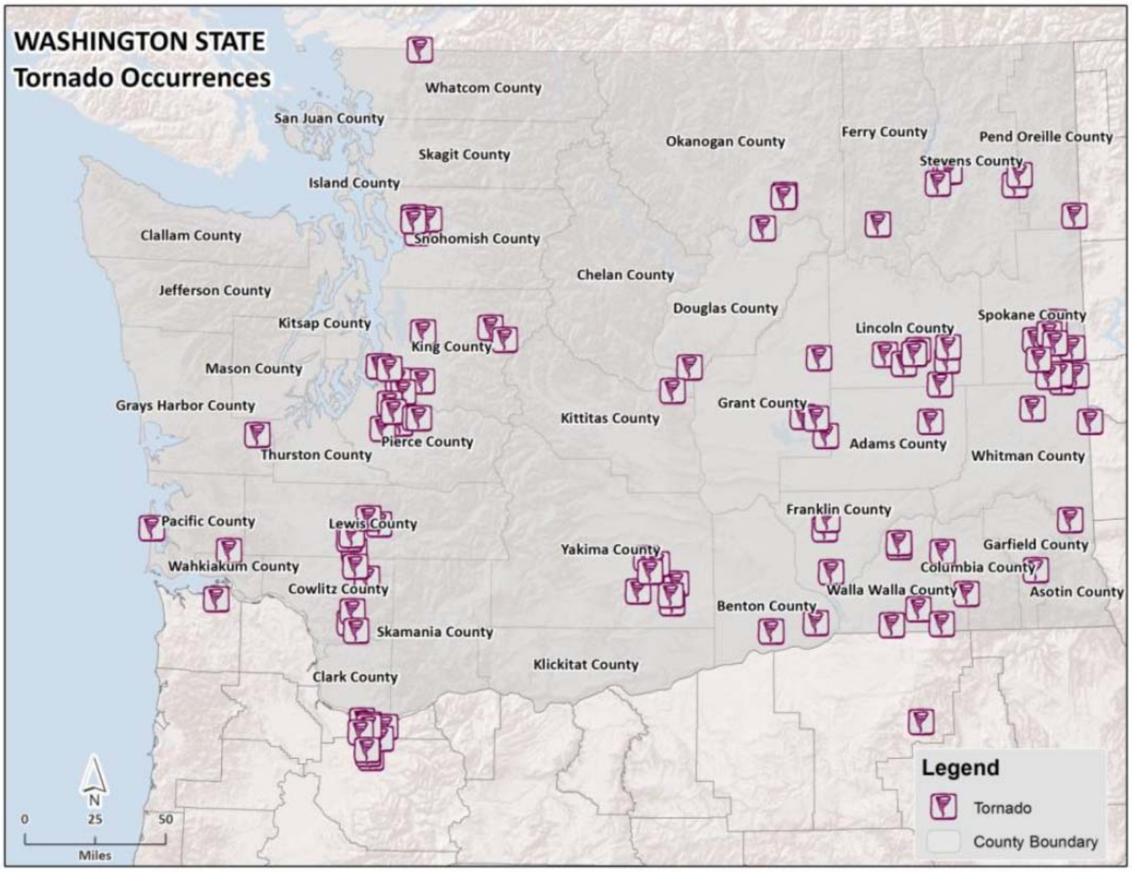
Tornadoes

Between 1954 and 2012, nearly 100 tornadoes have been reported in Washington State, as shown in Figure 7.2 on the following page. The vast majority of these tornadoes were small, F0 or F1, on the Fujita Scale; or, EF-0 or EF-1, on the Enhanced Fujita Scale. Such small tornadoes often result in minor roof damage but do not generally cause significant damage to buildings, and rarely result in significant injuries or deaths.

The most severe tornado outbreak in Washington occurred in April 1972. An F3 tornado hit Vancouver with six deaths, about 300 injuries, and about $50 million in damages. On this same day, there was an F3 near Spokane and an F2 in rural Stevens County.

For K–12 facilities, the risk of significant damage and casualties from tornadoes is very low but not zero. Given the low level of risk, mitigation measures such as building safe rooms are not practical or cost-effective. However, the South Whidbey School District's emergency plan should include identifying the best available safe area in each school if a tornado were to occur. This area should be a small, interior room with the fewest windows, ideally with no windows.

Figure 8.2
Washington State Tornadoes Since 1950[1]



Extreme Temperatures

Extreme cold or extreme heat both pose some risks to students and staff, especially for those that walk or bicycle to/from school. Proactive decisions to close schools are sometimes made for either extreme cold or extreme heat periods. Closures during extreme heat are more likely for schools without air conditioning.

Extreme temperatures also pose some risk to school facilities in several ways:

- Heating and air conditioning systems in schools are more prone to equipment failures at times of extreme demand, such as during periods of extreme temperatures.
- Water pipes in poorly insulated school buildings may freeze during periods of extreme cold, resulting in burst pipes and water damage.
- Utility systems providing electric power and water to schools are more prone to failures during periods of extreme temperatures:
    - o Electric power systems have more failures during periods of either extreme cold or extreme heat and such power outages may require school closures, depending on the duration of the outage.

    - Potable water systems may suffer damage during periods of extreme cold, especially small, rural systems with small diameter water pipes with low water flow rates. Loss of water supply typically necessitates school closures.

Severe Weather Events for the South Whidbey School District

Wind, snow and cold weather are the most likely severe weather events South Whidbey School District will experience. In the last 20 years, the district has experienced damage due to severe weather including the following:

- Minor roof damage due to wind
- Frozen pipes during cold weather
- Roof leaks due to snow buildup
- Electrical equipment failure related to weather related power outages

Following the emergency response plan, drainage inspection plan and winter weather checklist will do much to minimize the negative consequences of severe weather in our district.

For the most part, addressing severe weather is more in the domain of emergency planning than mitigation planning. Emergency planning measures include developing and practicing responses for events that may require shelter in place (such as tornado warnings) or events that may require evacuations (such as power outages, loss of water service, or loss of air conditioning or heating during periods of extreme heat or cold).

Possible mitigation measures for severe weather events include the following:

- High Wind Events
    - Tie-downs for portable buildings.
    - Increased trimming for trees near above ground electric power lines feeding a school or large trees near school buildings.
    - Installing wind-resistant roofing materials for schools in high wind areas or with a history of wind damage to roofs.
- Snow and Ice Storms
    - Increased trimming for trees as for high winds as noted above.
    - Evaluate and possibly retrofit older buildings, especially large span buildings that may have been designed for inadequate snow loads.
- Extreme temperatures
    - Maintain heating and cooling systems in good working order and replace systems near the end of their useful life.
    - Insulate water pipes with a history of freezing or with poor insulation, in locations with frequent extended periods of below freezing temperatures.

- All Severe Weather Events
    - Install back-up power systems for selected district facilities, such as those designated as emergency shelters.

8.3 Subsidence

The term “subsidence” refers to the lowering of ground elevations, which may occur gradually over long time periods or very suddenly for several reasons:

- Gradual subsidence which typically occurs from ground water pumping or petroleum extraction,
- Gradual or sudden subsidence from ground failures in locations of historical underground coal mining, and
- Sudden subsidence along the Pacific Coast which will occur from a major interface earthquake on the Cascadia Subduction Zone.

Subsidence at any given location which occurs gradually and smoothly over a large area may be almost imperceptible and have little or no impact on buildings. However, subsidence that is sudden can result in substantial damage to buildings and underground utility lines, especially at soil type boundaries where there may be discontinuities in the extent of subsidence.

For schools located on or near the Pacific Ocean coast, subsidence from an M9.0 earthquake on the Cascadia Subduction Zone will range from approximately 1 meter to 3 meters, depending on location. This level of subsidence will significantly increase flood risk for school campuses at low elevations near the coast and may result in significant building damage if the extent of subsidence varies across a given campus. This type of subsidence may also result in flooding which could block some evacuation routes for locations subject to tsunamis.

None of South Whidbey School Districts facilities are known to be at increased risk from subsistence.

References

1. Washington State Enhanced Hazard Mitigation Plan (2013). Washington State Military Department, Emergency Management Division.

Table 8.1
South Whidbey School District: Other Natural Hazards Mitigation Action Items

Hazard	Action Item	Timeline	Source of Funds	Responsible Party	Plan Goals Addressed			
					Life Safety	Protect Facilities	Enhance Emergency Planning	Enhance Awareness and Education
Other Natural Hazards Mitigation Action Items								
Short-Term #1	Evaluate portable buildings to make sure that they are adequately tied down to resist high winds and implement mitigation measures, if necessary.	1-3 Years	District and Grants	Supt.	X	X		
Short-Term #2	Review and implement district emergency response plan for facilities	On-going	District and Grants	Supt.	X	X	X	X
Short-Term #3	Review and implement winter weather facility checklist.	On-going	District and Grants	Supt.	X	X	X	X
Short-Term #4	Review and update emergency response plan evacuation routes in terms of natural hazards.	On-going	District and Grants	Supt.	X		X	X
Short Term #5	Evaluate each district site and develop plan for tree trimming or removal to better protect facilities from damage due to severe weather.	1-3 Years	District and Grants	Supt.	X	X	X	X

APPENDIX 1

FEMA MITIGATION GRANT PROGRAMS

2016

FEMA FUNDING POSSIBILITIES

FOR SCHOOL DISTRICTS IN WASHINGTON

Overview

For public entities in Washington, including school districts, FEMA mitigation funding possibilities fall into two main categories:

- The post-disaster Public Assistance Program which covers at least 75% of eligible emergency response and restoration (repair) costs for public entities whose facilities suffer damages in a presidentially-declared disaster. The Public Assistance Program also may fund mitigation projects for facilities damaged in the declared event.
- Mitigation grant programs (either pre-disaster or post-disaster) which typically cover 75% of mitigation costs, although in some cases, FEMA mitigation grants provide 90% or 100% funding.

These grants programs are summarized below. For more detailed information, see the references to FEMA publications in the narratives below.

For the South Whidbey School District, the sources of possible FEMA grant funds include the Public Assistance Program, the Hazard Mitigation Grant Program, and the Pre-Disaster Mitigation Program.

FEMA Public Assistance Program

The objective of the Federal Emergency Management Agency's (FEMA) Public Assistance (PA) Grant Program is to provide funding so that communities can quickly respond to, and recover from, major disasters or emergencies declared by the President. The PA program is sometimes referred to as the 406 program because it is authorized under Section 406 of the Stafford Act which established FEMA's disaster programs.

Through the PA Program, FEMA provides supplemental Federal disaster grant assistance for debris removal, emergency protective measures, and the repair, replacement, or restoration of disaster-damaged, publicly-owned facilities and the facilities of certain private non-profit (PNP) organizations.

PA funding for school facilities is available only when:

- There is a presidentially-declared disaster in Washington State,
- A facility is located in a county included in the disaster declaration, and
- A facility had damage in the declared disaster event.

The PA Program also encourages protection of these damaged facilities from future events by providing assistance for hazard mitigation measures during the recovery process. The PA Program's distinction between repairs and mitigation is important:

- Repairs restore a damaged facility to its pre-disaster condition, with the possible addition of code-mandated upgrades.
- Mitigation measures go beyond repairs to make the facility more resistant to damage in future disaster events.

Under the PA Program, FEMA funding for repairs of damaged facilities and for the other categories of PA assistance are largely automatic, subject only to FEMA's eligibility criteria.

However, mitigation measures under the PA Program and at the discretion of FEMA are not automatically funded. Mitigation measures under PA have to meet eligibility criteria very similar to those for the other FEMA mitigation grant programs, including having a benefit-cost ratio greater than 1.0. However, Public Assistance mitigation projects are automatically determined to be cost effective and a project-specific benefit-cost analysis is not required if the cost of mitigation is no more than the following percentages of the repair costs:

- 15% of the repair costs for any PA-eligible mitigation project, or
- 100% of the repair costs for categories of mitigation projects defined in the March 30, 2010 version of FEMA Recovery Policy RP9526.1 Hazard Mitigation Funding Under Section 406 (Stafford Act).

Further details of FEMA's PA programs are available on FEMA's website at:

http://www.fema.gov/site-page/public-assistance-grant-program

FEMA Mitigation Grant Programs

The Federal Emergency Management Agency (FEMA) has three mitigation grant programs which provide federal funds to supplement local funds for specified types of mitigation activities.

For school districts, an important eligibility criterion for all FEMA mitigation grants is that a district must have a FEMA-approved hazard mitigation plan or be covered by a city or county FEMA-approved hazard plan for which the district participated in the planning process.

There are two distinct types of FEMA mitigation grant programs:

1. The post-disaster Hazard Mitigation Grant Program (HMGP) for which funds are available in Washington State after each presidentially-declared disaster in Washington State.
2. Annual pre-disaster programs for which funds are available nationwide, including:
    - The Pre-Disaster Mitigation (PDM) program which includes mitigation for all natural hazards, and
    - The Flood Mitigation Assistance (FMA) program which includes mitigation for flood only, with a focus predominantly on facilities with flood insurance.

Further details of these mitigation grant programs are provided in the following two FEMA publications:

Hazard Mitigation Assistance Unified Guidance (July 2013), and

Addendum to the Hazard Mitigation Unified Guidance (July 2013).

Additional information is available on the FEMA website:

www.fema.gov/hazard-mitigation-assistance

Each of the FEMA mitigation grant programs has specific eligibility requirements, applications, and application deadlines, which may vary from year to year. These grant programs are not entitlement programs, but rather are competitive grant programs which require strict adherence to the eligibility and application requirements and robust documentation.

All physical mitigation projects (but not mitigation planning) must be cost-effective, which for FEMA means a benefit-cost ratio >1.0. Therefore, most FEMA mitigation projects require completing a benefit-cost analysis using FEMA software and following FEMA's detailed benefit-cost analysis guidance.

However, there are three categories of mitigation projects which are automatically determined to be cost-effective and thus do not require a project-specific benefit-cost analysis for HMGP and FMA grant applications:

- Acquisition of properties within a Special Flood Hazard Area - 100-year, FEMA-mapped floodplain – when the structure is substantially damaged. Substantial damage is defined as: "damage of any origin sustained by a structure whereby the cost of restoring the structure to its before damaged condition would equal or exceed 50% of the market value of the structure before the damage occurred."
- Acquisition or elevation projects with a Special Flood Hazard Area that meet the cost limits established in the FEMA Memorandum "Cost Effectiveness Determinations for Acquisitions and Elevations in Special Flood Hazard Areas," August 15, 2013.
- Acquisition or relocation of residential structures subject to landslide hazards that meet the criteria in the FEMA Memorandum "Use of HMGP Funds for Acquisition or Relocation of Residential Structures Subject to Landslide Hazards," July 22, 1998.

Hazard Mitigation Grant Program

The Hazard Mitigation Grant Program (HMGP) is a post-disaster grant program. HMGP funds are generated following a Presidential Disaster Declaration for Washington State. Declared disasters for Washington are relatively common, often with one or more declarations in a given year for winter storms, floods, or other disasters.

The amount of HMGP grant funding available after a given declared disaster is a percentage of total FEMA spending for various other FEMA programs such as the Individual and Family Assistance and Public Assistance programs. Thus, the total amount of HMGP mitigation funds available within Washington will vary from year to year and disaster event to disaster event. In some years, there may be no HMGP funding available. However, after a major disaster, such as the Nisqually earthquake in 2001, a large amount of HMGP funding may be available.

The Washington Emergency Management Division (WA-EMD) of the Washington Military Department administers the HMGP in Washington State and sets the priorities and guidelines after each disaster. For HMGP mitigation grants, WA-EMD selects the mitigation projects for funding, with FEMA's only role being to verify that a submitted project meets FEMA's minimum eligibility criteria. HMGP is the most flexible grant program: grants may be possible for any natural hazard and may include hazard mitigation planning and risk assessments as well as physical mitigation projects.

For HMGP applications, WA-EMD's application process has included the following steps after a declared disaster in Washington:

- Public announcement of HMGP funds availability and guidance re: priorities and grant award limits,
- Review of submitted NOIs and selection of projects for which full applications are requested,
- Review of submitted applications and requests for additional documentation.
- Selection of applications to be submitted to FEMA.
- FEMA approval of grants, for applications that meet FEMA's minimum criteria for eligibility.

In past disasters, Washington State has typically provided one-half of the applicants FEMA-required 25% local matching funds for HMGP grants. In this case, the FEMA grant covers 75% of the total project cost, with Washington State and the applicant each providing 12.5%. That is, the local match required has been only 12.5% of the total eligible project cost. However, continuation of the state's 12.5% match in future declared disasters is contingent upon legislative approval.

Annual Pre-Disaster Grant Programs

FEMA's annual pre-disaster grant programs – Pre-Disaster Mitigation (PDM) and Flood Mitigation Assistance (FMA) are contingent upon future congressional approval.

WA-EMD processes grant applications for these programs in a step-wise manner generally similar to that described above for HMGP grant applications. However, there are two important differences:

- For these programs WA-EMD forwards ranked applications to FEMA, but FEMA makes the grant determinations, which may or may not match WA-EMD's rankings. Thus, applications for these programs are competitive nationally, not just within Washington State, although there may be partial set-asides guaranteeing Washington some level of funding, if submitted applications meet FEMA's eligibility criteria.
- For these grant programs, Washington State does not provide any matching funds; thus, applicants must provide the full FEMA-required local match percentage.

Pre-Disaster Mitigation (PDM) Grant Program

The PDM grant program is a broad program which includes mitigation projects for any natural hazard as well as mitigation planning grants which must result in the development of a Local Hazard Mitigation Plan.

PDM grants typically cover 75% of the costs of mitigation projects up to a maximum federal share of $3,000,000 per project. However, for eligible local government applicants in communities that meet FEMA's definition of small, impoverished community, the Federal share may be 90%.

Flood Mitigation Assistance (FMA)

The FMA grant program funds only flood projects, with its predominant focus being on flood mitigation projects for properties with flood insurance. FMA special emphasis and priorities on properties which are on FEMA's national listing of Repetitive Flood Loss (RFL) and Severe Repetitive Loss (SRL) properties.

FMA grants generally cover 75% of total eligible project costs, with 25% local match required. However, grants for Repetitive Loss properties provide 90% FEMA funding and grants for Severe Repetitive Loss properties provide 100% FEMA funding.

General Guidance for FEMA Grant Applications

All of FEMA's mitigation grant programs are competitive, either within a given state or nationally. Thus, successful grant applications must be complete, robust, and very well documented. The key elements for successful mitigation project grant applications include:

- Project locations within high hazard areas.
- Project buildings or infrastructure that have major vulnerabilities which pose substantial risk of damages, economic impacts, and (especially for seismic projects) deaths or injuries.
- Mitigation project scope is well defined with at least a conceptual design with enough detail to support a realistic engineering cost estimate for the project.
- The benefits of the project are carefully documented using FEMA benefit-cost software, with all inputs meticulously meeting FEMA's guidance and expectations. A benefit-cost analysis meeting FEMA's requirements is very often the most critical step in determining a mitigation project's eligibility and competitiveness for FEMA grants.
- Making sure that the proposed project is eligible for the specific FEMA grant program to which it is being submitted.
- Making sure that the application is 100% complete with credible information and easy for FEMA to understand.

The effort required for developing a good mitigation project and completing a successful grant application varies with the size and complexity of the mitigation project. In some cases, a successful FEMA grant application requires technical expertise, which may be available on-staff within a given local government entity, or which may require outside consulting support. For example, technical expertise may be desired for:

- Understanding the level of hazard (flood, earthquake, tsunami, etc.) at a given location.
- Quantifying the vulnerability of the building(s) exposed to the hazard at the project site(s).
- Developing a preliminary or conceptual engineering design for the mitigation project.
- Developing a realistic engineering cost estimate for the mitigation project.
- Completing the benefit-cost analysis in full conformance with FEMA's guidance and expectations, along with robust documentation of the credibility of the inputs into the benefit-cost analysis.

Good mitigation projects which address high-risk situations are effective in reducing future damages and losses, with robust, well-documented applications have a reasonable chance of FEMA funding. Conversely, weakly conceived or poorly documented projects have little or no chance of FEMA funding.

Guidance for FEMA grant applications is available on the FEMA website (www.fema.gov/hazard-mitigation-assistance) and in the FEMA guidance document referenced previously. Thorough review of this guidance is strongly encouraged before undertaking a FEMA grant application.

Additional guidance is also available on Washington Emergency Management's website (www.emd.wa.gov), see Grants category, and from WA-EMD's mitigation staff.

APPENDIX 2

PRINCIPLES

OF

BENEFIT-COST ANALYSIS

2016

Introduction

Benefit-cost analysis is required for nearly all FEMA mitigation project grant applications for all FEMA grant programs with only three exceptions:

- Acquisition or relocation of facilities located within FEMA-mapped 100-year floodplains that have been determined to be substantially damaged, and
- Public Assistance mitigation projects with costs less than 15% of repair costs, and
- Several types of Public Assistance mitigation projects that have costs less than 100% of repair costs.

FEMA's definition of substantial damage is "damage of any origin sustained by a structure whereby the cost of restoring the structure to its before damaged condition would equal or exceed 50% of the market value of the structure before the damage occurred." The categories of Public Assistance mitigation projects which do not require benefit-cost analysis are listed in FEMA Disaster Assistance Policy 9526.1 (March 30, 2010).

For all FEMA-funded mitigation projects, other than the exceptions noted above, the benefit-cost ratio must be greater than 1.0 for a project to be eligible for FEMA funding. The benefit-cost ratio must be calculated using FEMA's benefit-cost analysis software, with all data inputs consistent with FEMA's guidance and expectations.

The primary references for FEMA benefit-cost analysis are:

BCA Reference Guide (June, 2009), and

Supplement to the Benefit-Cost Analysis Reference Guide (June, 2011).

In addition to the above monographs, there are numerous other FEMA publications related to benefit-cost analysis which are available on the FEMA website:

www.fema.gov/benefit-cost-analysis

Help is also available via:

bchelpline@fema.dhs.gov and at 1-855-540-6744.

What are Benefits?

The benefits of a hazard mitigation project are the reduction in future damages and losses; that is, the avoided damages and losses that are attributable to a mitigation project. To conduct benefit-cost analysis of a specific mitigation project, the risk of damages and losses must be evaluated twice: before mitigation and after mitigation, with the benefits being the difference.

The categories of benefits included in FEMA benefit-cost analysis varies with the type of facility being mitigated, the hazard being addressed and the type of mitigation project. Common categories of benefits include the reductions in: building damages, contents damages, displacement costs for temporary quarters if a building is damaged, the economic impacts of loss of service from a damaged facility and casualties. The economic value of avoided deaths and injuries are calculated using FEMA's standard statistical values for deaths and injuries.

Some mitigation projects, such as most flood mitigation projects, focus predominantly on reducing future damages and losses. Other mitigation projects, such as most earthquake mitigation projects, focus on reducing casualties as well as reducing damages and losses; in this case, life safety is often the primary motivation for the mitigation project. In some cases, such as tsunami vertical evacuation mitigation projects, life safety is the sole purpose of a mitigation project.

More precisely, a benefit-cost ratio is calculated as the net present value of benefits divided by the mitigation project cost. Net present value means that the time value of money must be considered; benefits that accrue in the future are worth less than those that accrue immediately. The FEMA benefit-cost software discussed in the next section automatically calculates the net present value of benefits from data inputs, including the mitigation project useful lifetime, which varies depending on the type of facility and type of project, and the FEMA-mandated discount rate of 7%.

Because the benefits of a hazard mitigation project accrue in the future, it is impossible to know exactly what they will be. For example, it cannot be known in advance when a future earthquake or other natural hazard event will occur in a given location or how severe the event will be. However, in most cases, it is possible to estimate the probability of future hazard events. Therefore, the benefits of mitigation projects must be evaluated statistically or probabilistically.

Hazard events don't come in only one size. Rather, the severity of every type of natural hazard event can range from minimal to severe. A benefit-cost analysis always considers a range of severity for hazard events, such as the 10-, 50-, 100- and 500-year floods, and the analysis includes estimates of the expected damages and losses for each level of event.

The FEMA benefit-cost software integrates such data to determine the average annual damages and losses considering the full range of hazard events. The term "average annual" damages and losses doesn't mean that such damage and losses occur every year, but rather represents the long term average from hazard events of many different severities and probabilities occurring.

FEMA Benefit-Cost Analysis Software

The current version of FEMA's benefit-cost analysis software (Version 5.0) may be downloaded and installed from the FEMA website noted previously. There are seven benefit-cost modules applicable to different types of hazards and different types of mitigation projects:

- Floods,
- Hurricane Winds,
- Earthquake Structural Projects,
- Earthquake Nonstructural Projects,
- Tornado Safe Rooms,
- Wildfire, and
- Damage Frequency Assessment.

The applicability of most of the above BCA modules is self-evident, with a couple of exceptions:

- The flood BCA module can be used only when a full set of quantitative flood hazard data is available, including first floor elevations of buildings, stream discharge and flood elevation data for four flood return periods (typically, the 10-, 50-, 100- and 500-year events) and stream bottom elevations. For coastal storm surge flooding, the above data are necessary, less the stream discharge and stream bottom elevation data.
- The Damage Frequency Assessment module is applicable for any natural hazard for which a damage-frequency relationship can be defined from historical data and/or engineering analysis/judgment.

All of the BCA modules, except for the Damage Frequency Assessment module, have some built-in data which significantly simplifies the BCA process. However, all of the modules also require a considerable number of user-defined data inputs to complete a benefit-cost analysis.

The Damage Frequency Assessment (DFA) module has no built-in data: all of the data inputs are user-defined. The DFA module is the most flexible module, but also the most difficult to use because it requires the most technical expertise to input FEMA-credible data.

The Damage Frequency Assessment BCA module is used for the following types of hazards and facilities:

- Tsunamis,
- Landslides,
- Flood projects where the quantitative flood hazard data necessary to use the flood BCA module are unavailable,
- Seismic projects for utility or transportation infrastructure,
- All other natural hazards for which a damage-frequency relationship can be defined, including snow storms, ice storms, erosion, avalanches, and others.

Benefit-cost analysis of most hazard mitigation projects is unavoidably complex and requires at least a basic technical understanding of facilities, hazards, vulnerability, risk, and the economic parameters of benefit-cost analysis. For many types of mitigation projects, especially seismic projects, technical support from an engineer is almost always necessary. For some mitigation projects, technical support from subject matter experts with experience in making estimates of damages, casualties, and economic losses for benefit-cost analysis may also be helpful.

Benefit-Cost Analysis: Use and Interpretation

For FEMA mitigation grants, the immediate use of benefit-cost analysis is to determine whether a project has a benefit-cost ratio above 1.0 and thus meets FEMA's eligibility criterion. However, benefit-cost analysis can also play are larger role in the evaluation and prioritization of mitigation projects.

Districts that are considering whether or not to undertake mitigation projects must answer questions that don't always have obvious answers, such as:

What is the nature of the hazard problem?

How frequent and how severe are hazard events?

Do we want to undertake mitigation measures?

What mitigation measures are feasible, appropriate, and affordable?

How do we prioritize between competing mitigation projects?

Are our mitigation projects likely to be eligible for FEMA funding?

Benefit-cost analysis is a powerful tool that can help districts provide solid, defensible answers to these difficult socio-political-economic-engineering questions. As noted previously, benefit-cost analysis is required for all FEMA-funded mitigation projects under both pre-disaster and post-disaster mitigation programs. However, regardless of whether or not FEMA funding is involved, benefit-cost analysis provides a sound basis for evaluating and prioritizing possible mitigation projects for any natural hazard.

Overall, benefit-cost analysis provides answers to a central question for hazard mitigation projects: "Is it worth it?" That is, are the benefits large enough to justify the costs necessary to implement a mitigation project?

Whether or not a mitigation project is "worth it" depends on many factors, including:

- The level of hazard at a given location,
- The value and importance of the facility being mitigated,
- The vulnerability of the facility to the hazard,
- The cost of the mitigation project,

- The effectiveness of the mitigation project in reducing future damages, economic losses, and casualties.

The best mitigation projects address high risk situations: a high level of hazard for an important facility which has substantial vulnerability to the hazard.

All well-designed mitigation projects reduce risk. However, just because a mitigation project reduces risk does not make it a good project. A $1,000,000 project that avoids an average of $100 per year in flood damages is not worth doing, while the same project that avoids an average of $200,000 per year in flood damages is worth doing.

Benefit-Cost Analysis Example

The principles of benefit-cost analysis are illustrated by the following simplified example. Consider a small building in the town of Acorn, located on the banks of Squirrel Creek. The building is a one story building; about 1500 square feet on a post foundation, with a replacement value of $60/square foot (total building value of $90,000). We have flood hazard data for Squirrel Creek (stream discharge and flood elevation data) and elevation data for the first floor of the house.

For this BCA, the FEMA flood BCA module is used, because the necessary quantitative flood hazard data are available. The data built into the BCA module, along with user data inputs, allow the module to calculate the annual probability of flooding in one-foot increments, along with the resulting damages and losses shown in Table A2.1.

Table A2.1
Damages Before Mitigation

Flood Depth (feet)	Annual Probability of Flooding	Scenario Damages and Losses Per Flood Event	Annualized Flood Damages and Losses
0	0.2050	$6,400	$1,312
1	0.1234	$14,300	$1,765
2	0.0867	$24,500	$2,124
3	0.0223	$28,900	$673
4	0.0098	$32,100	$315
5	0.0036	$36,300	$123
		Total Expected Annual (Annualized) Damages and Losses	**$6,312**

Flood depths shown above in Table A2.1 are in one foot increments of water depth above the lowest floor elevation. Thus, a "3" foot flood means all floods between 2.5 feet and 3.5 feet of water depth above the floor. We note that a "0" foot flood has, on average, damages because this flood depth means water plus or minus 6" of the floor; even if the flood level is a few inches below the first floor, there may be damage to flooring and other building elements because of wicking of water.

The Scenario (per flood event) damages and losses include expected damages to the building, content, and displacement costs if occupants have to move to temporary quarters while flood damage is repaired.

The Annualized (expected annual) damages and losses are calculated as the product of the flood probability times the scenario damages. For example, a 4-foot flood has slightly less than a 1% chance per year of occurring. If it does occur, we expect about $32,100 in damages and losses. Averaged over a long time, 4-foot floods are thus expected to cause an average of about $315 per year in flood damages.

Note that the smaller floods, which cause less damage per flood event, actually cause higher average annual damages because the probability of smaller floods is so much higher than that for larger floods. With these data, the building is expected to average $6,312 per year in flood damages. This expected annual or "annualized" damage estimate does not mean that the building has this much damage every year. Rather, in most years there will be no floods, but over time the cumulative damages and losses from a mix of relatively frequent smaller floods and less frequent larger floods is calculated to average $6,312 per year.

The calculated results in Table A2.1 are the flood risk assessment for this building for the as-is, before mitigation situation. The table shows the expected levels of damages and losses for scenario floods of various depths and also the annualized damages and losses.

The risk assessment shown in Table A2.2 shows a high flood risk, with frequent severe flooding which the owner deems unacceptable. The owner explores mitigation alternatives to reduce the risk: the example below is to elevate the house 4 feet. These results are shown in Table A2.2.

Table A2.2
Damages After Mitigation

Flood Depth (feet)	Annual Probability of Flooding	Scenario Damages and Losses Per Flood Event	Annualized Flood Damages and Losses
0	0.2050	$0	$0
1	0.1234	$0	$0
2	0.0867	$0	$0
3	0.0223	$0	$0
4	0.0098	$6,400	$63
5	0.0036	$14,300	$49
Total Expected Annual (Annualized) Damages and Losses			**$112**

By elevating the building 4 feet, the owner has reduced the expected annual (annualized) damages from $6,312 to $112 (a 98% reduction) and greatly reduced the probability or frequency of flooding affecting the building. The annualized benefits are the difference in the annualized damages and losses before and after mitigation or $6,312 - $112 = $6,200.

Is this mitigation project worth doing? Common sense says yes, because the flood risk appears high: the annualized damages before mitigation are high ($6,312). To answer this question more quantitatively, we complete our benefit-cost analysis of this project. One key factor is the cost of mitigation. A mitigation project that is worth doing at one cost may not be worth doing at a higher cost. Let’s assume that the elevation costs $20,000. This $20,000 cost occurs once, up front, in the year that the elevation project is completed.

The benefits, however, accrue statistically over the lifetime of the mitigation project. Following FEMA guidance for this type of project, we assume that this mitigation project has a useful lifetime of 30 years. Money (benefits) received in the future has less value than money received today because of the time value of money. The time value of money is taken into account with present value calculation. We compare the present value of the anticipated stream of benefits over 30 years in the future to the up-front out-of-pocket cost of the mitigation project.

A present value calculation depends on the useful lifetime of the mitigation project and on what is known as the discount rate. The discount rate may be viewed simply as the interest rate you might earn on the cost of the project if you didn’t spend the money on the mitigation project. Let’s assume that this mitigation project is to be funded by FEMA, which uses a 7% discount rate to evaluate hazard mitigation projects. With a 30-year lifetime and a 7% discount rate, the “present value coefficient” which is the value today of $1.00 per year in benefits over the lifetime of the mitigation project is $12.41. That is, each $1.00 per year in benefits over 30 years is worth $12.41 now. The benefit-cost results are now as follows.

Table A2.3
Benefit-Cost Results

Annualized Benefits	$6,200
Present Value Coefficient	12.41
Net Present Value of Future Benefits	$76,942
Mitigation Project Cost	$20,000
Benefit-Cost Ratio	3.85

These results indicate a benefit-cost ratio of 3.85. Thus, in FEMA's terms, the mitigation project is cost-effective and eligible for FEMA funding.

Taking into account the time value of money (essential for a correct economic calculation), results in lower benefits than if we simply multiplied the annual benefits times the project's 30-year useful lifetime. Economically, simply multiplying the annual benefits times the project lifetime would ignore the time value of money and thus would yield an incorrect result.

The above discussion of benefit-cost analysis of a flood hazard mitigation project illustrates the basic concepts.

The actual FEMA BCA modules calculate each category of damage or loss separately and the specific built-in data and the specific user-input data vary from module to module, depending on the hazard, type of facility, and type of mitigation project.