ARLINGTON
Public Schools

*Educating all students, preparing & inspiring them to achieve their full potential*

# HAZARD MITIGATION PLAN

# ARLINGTON PUBLIC SCHOOLS

## May 8, 2017

**Arlington Public Schools**
**135 North French Avenue**
**Arlington WA  98223**

The 2017 Arlington Public Schools' 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.

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# EXECUTIVE SUMMARY

The Arlington Public Schools Hazard Mitigation Plan covers each of the major natural hazards that pose significant threats to the District.

The Mission Statement of the Arlington Public Schools Hazard Mitigation Plan is to:

> Proactively facilitate and support district-wide policies, practices, and programs that make the Arlington Public Schools more disaster resistant and disaster resilient.

Making the Arlington Public Schools 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.

Completely eliminating the risk of future disasters in the Arlington Public Schools 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.

Mitigation simply means actions that reduce the potential for negative consequences from future disasters. That is, mitigation actions reduce future damages, losses, and casualties. Effective mitigation planning will help the Arlington Public Schools 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.

This mitigation plan focuses on the hazards that pose the greatest threats to the District's facilities and people. For the Arlington Public Schools this is "Earthquake". Other natural hazards that pose lesser threats are addressed briefly.

# 1.0 INTRODUCTION

## 1.1 What is a Hazard Mitigation Plan?

The Arlington Public Schools 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 Arlington Public Schools 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 Arlington Public Schools Hazard Mitigation Plan is to:

> Proactively facilitate and support district-wide policies, practices and programs that make the Arlington Public Schools more disaster resistant and disaster resilient.

Making the Arlington Public Schools 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 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 Arlington Public Schools 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.

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 Arlington Public Schools mitigation plan has several key elements:

1. Each hazard that may significantly affect the Arlington Public Schools' facilities is reviewed to estimate the probability (frequency) and severity of likely natural hazard events.

2. The vulnerability of Arlington Public Schools 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 Arlington Public Schools and that are desirable from the community's political and economic perspectives.

### 1.2 Why is Mitigation Planning Important for the Arlington Public Schools?

Effective mitigation planning will help the Arlington Public Schools 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 Arlington Public Schools' 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 Arlington Public Schools Hazard Mitigation Plan

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

The reviews of the hazards and the vulnerability of the Arlington Public Schools 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 Arlington Public Schools.

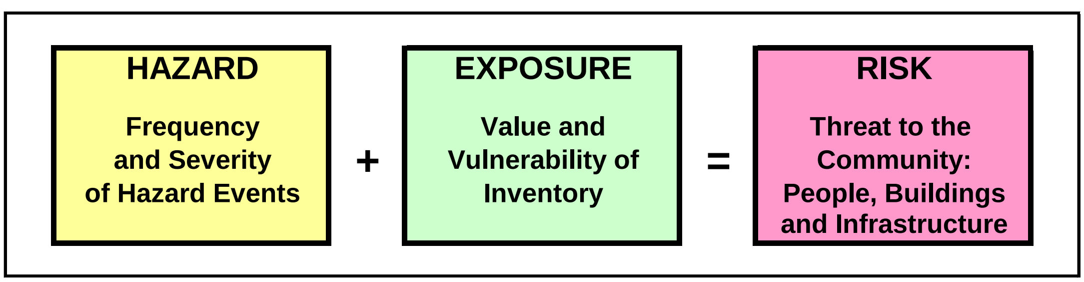
The Arlington Public Schools Hazard Mitigation Plan deals with hazards realistically and rationally and also strikes a balance between suggested physical mitigation actions to eliminate or reduce the negative consequences of future disasters and planning measures which better prepare the community to 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 Arlington Public Schools 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**



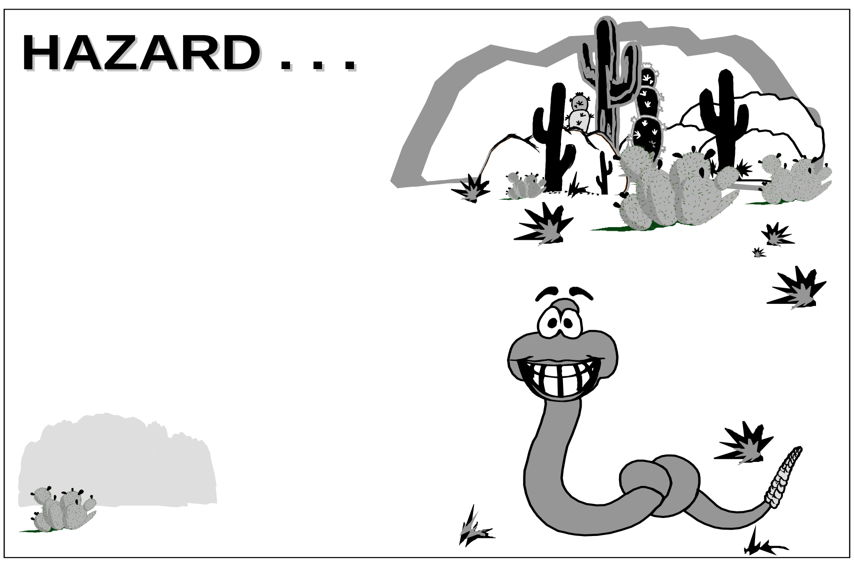

Risk is generally expressed in dollars (estimates of potential damages and other economic losses) and in terms of casualties (numbers of deaths and injuries).

There are four key concepts that govern hazard mitigation planning: hazard, exposure, risk and mitigation.

**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 <u>not</u> 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.

**Figure 1.2**
**Hazard Alone Does Not Produce Risk**



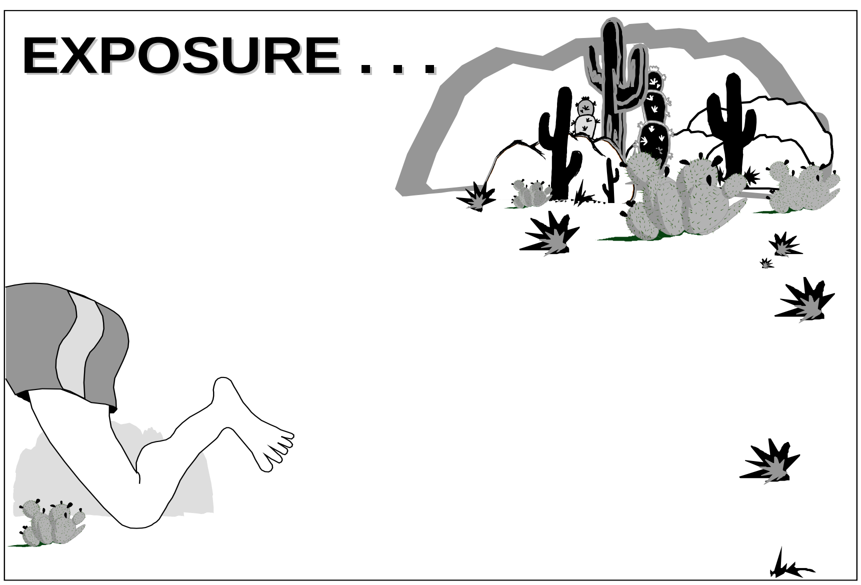

The important point is that hazards do not necessarily produce risk to people and property, unless there is vulnerable inventory exposed to the hazard. Risk to people, buildings or infrastructure results only when hazards are combined with an exposure to the hazard.

**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 Arlington Public Schools, 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.

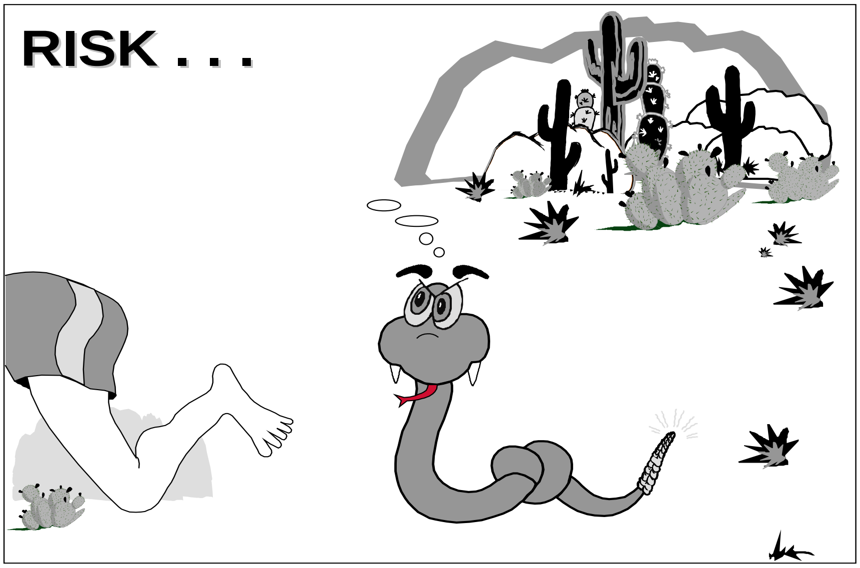
For hazard mitigation planning, inventory must be characterized not only by the quantity and value of buildings or infrastructure present but also by its vulnerability to each hazard under evaluation. For example, a given facility may or may not be particularly vulnerable to flood damages or earthquake 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.

**Figure 1.3**
**Exposure (Quantity, Value and Vulnerability of Inventory)**




**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.

**Figure 1.4**
**Risk Results from the Combination of Hazard and Exposure**




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 an 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 taken 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**

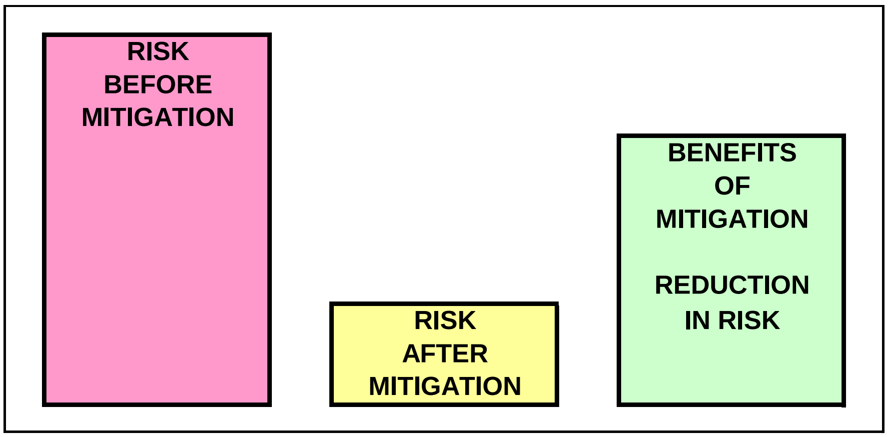
| Hazard | Common Mitigation Projects |
|---|---|
| **Earthquake** | Structural retrofits for buildings |
| | Nonstructural retrofits for building elements and contents |
| | Replace existing building with new, current-code building |
| **Tsunami** | Enhance evacuation planning, including practice drills |
| | Build structure for vertical evacuation |
| **Volcanic Hazards** | Enhance evacuation planning, including practice drills |
| **Floods** | Flood barriers and other floodproofing measures |
| | Elevate at risk buildings |
| | Abandon campus at high risk (possible FEMA buyout) and build new campus outside of floodplain |
| **Wildland/Urban Interface Fires** | Enhance defensible space around buildings |
| | Fuel reduction measures near campus |
| | Improve fire resistance of existing buildings with non-flammable roofs and exterior finishes and other fire-safe measures |
| **Landslides** | Stabilize slopes with improved drainage and/or retaining walls. |
| **Multi-Hazard** | Replace vulnerable facility with new current-code facility, outside of high hazard zones when possible |
| | Obtain insurance to cover some damage/losses |
| | Enhance emergency planning, including drills |
| | Expand education/outreach to improve community understanding of natural hazards |

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 in figure 1.5.

**Figure 1.5**
**Mitigation Projects Reduce Risk**



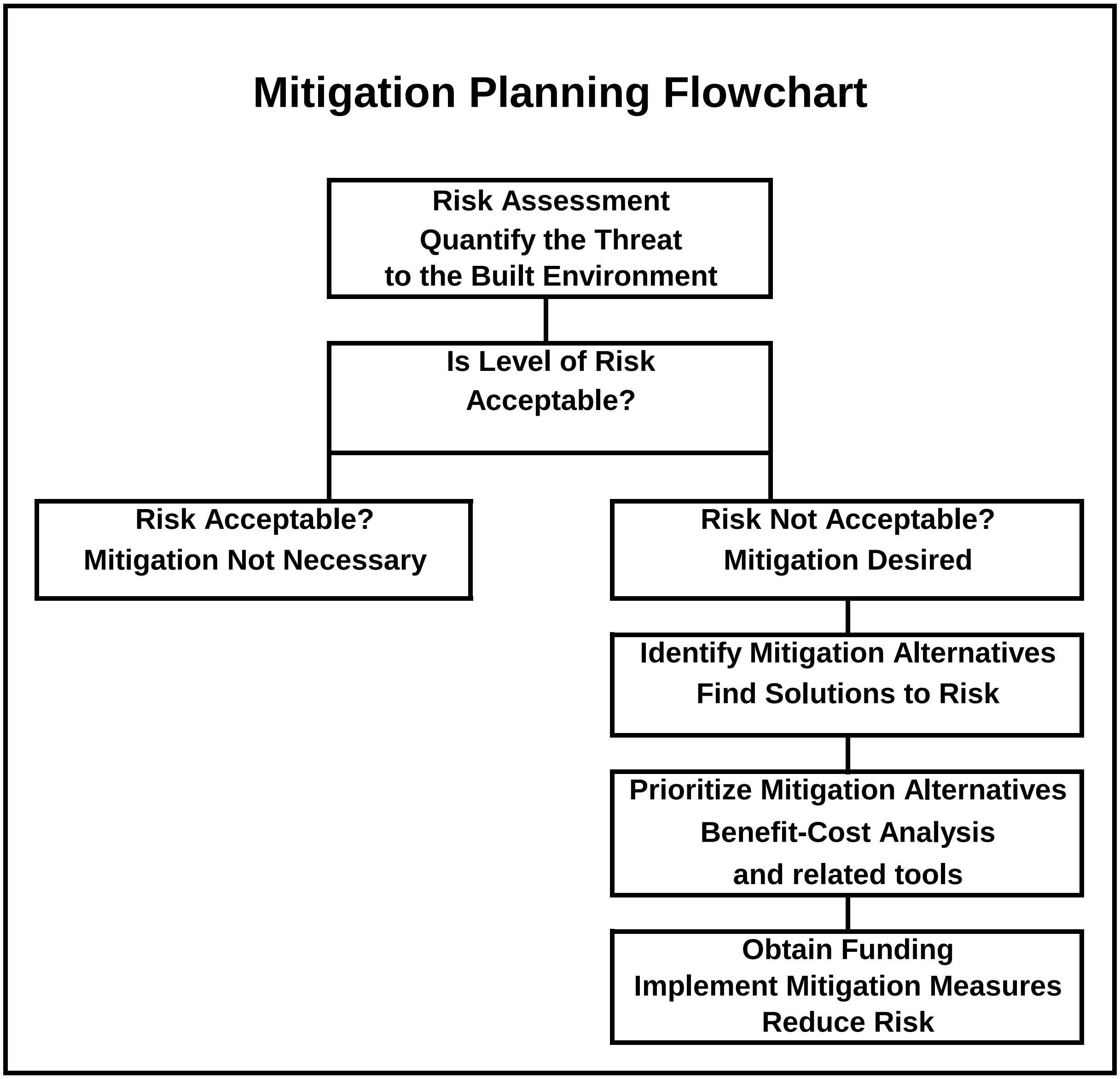

Quantifying the benefits of a proposed mitigation project is an essential step in hazard mitigation planning and implementation. Only by quantifying benefits is it possible to compare the benefits and costs of mitigation to determine whether or not a particular project is worth doing (i.e., whether it 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 Arlington Public Schools.

**Figure 1.6**
**The Mitigation Planning Process**




The first steps are quantitative evaluation of the hazards (frequency and severity) affecting the Arlington Public Schools 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 Arlington Public Schools.

The next key step is to determine whether or not the level of risk posed by each of the hazards affecting the Arlington Public Schools 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 Arlington Public Schools.

## 1.6 The Role of Benefit-Cost Analysis in Mitigation Planning

Communities, such as the Arlington Public Schools, 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 <u>required</u> 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.

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 geographic information systems (GIS) data and additional district-specific data entered into the Office of the Superintendent of Public Instruction's (OSPI) Information and Condition of Schools (ICOS) Pre-Disaster Mitigation (PDM) database. The Arlington Public Schools Hazard Mitigation Plan addresses each of the major natural disasters that pose significant threats to District facilities.

**Figure 1.7**
**Arlington Public Schools: Major Hazards Matrix**

**STATE OF WASHINGTON**
**SUPERINTENDENT OF PUBLIC INSTRUCTION**
**DISTRICT PDM HAZARD SUMMARY**

| **Arlington** | **Earthquake** | **Tsunami** | **Volcanic** | **Flood** | **WUI** | **Landslide** |
|---|---|---|---|---|---|---|
| "A" Building and District Storage | High | None** | None** | None** | None** | None** |
| Arlington High School | High | None** | None** | None** | None** | None** |
| District Administration | High | None** | None** | None** | None** | None** |
| Eagle Creek Elementary School | High | None** | None** | None** | None** | None** |
| Haller Middle School | High | None** | None** | None** | None** | None** |
| Kent Prairie Elementary School | High | None** | None** | None** | None** | Low |
| Pioneer Elementary School | High | None** | None** | None** | None** | None** |
| Post Middle School | High | None** | None** | None** | None** | Moderate to High |
| Presidents Elementary School | High | None** | None** | None** | None** | None** |
| Stillaguamish Valley School | High | None** | None** | None** | None** | None** |
| Trafton Elementary School | High | None** | None** | None** | None** | None** |
| Transportation | High | None** | None** | None** | None** | None** |
| Weston High School | High | None** | None** | None** | None** | None** |

Note: Landslide hazard levels in Figure 1.7 have been edited to reflect the district-specific information in Chapter 7 as outlined in the notes following Table 7.1.

All of the Arlington Public Schools' campuses have high levels of earthquake hazard because of their proximity to many active earthquake faults. A high hazard level doesn't necessarily mean high risk. The level of earthquake risk for each building depends upon the design and condition of each building. Further details are provided in Chapter 6.

Two of the campuses have some degree of exposure to landslide hazard which appears low for Kent Prairie Elementary School and moderate to high for Post Middle School.

The Arlington Public Schools are 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.

Nor are the Arlington Public Schools subject to tsunamis because the district is located many miles from the coast and at elevations above any possible tsunami events.

There are no significant wild land/urban interface fire risks because all campuses have limited vegetative fuel load, good defensible space and access to city water for fire suppression.

There are no significant flood risks for the campuses because all are well above FEMA mapped floodplains, are not near un-mapped streams, and have no history of significant problems with localized storm water drainage flooding.

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

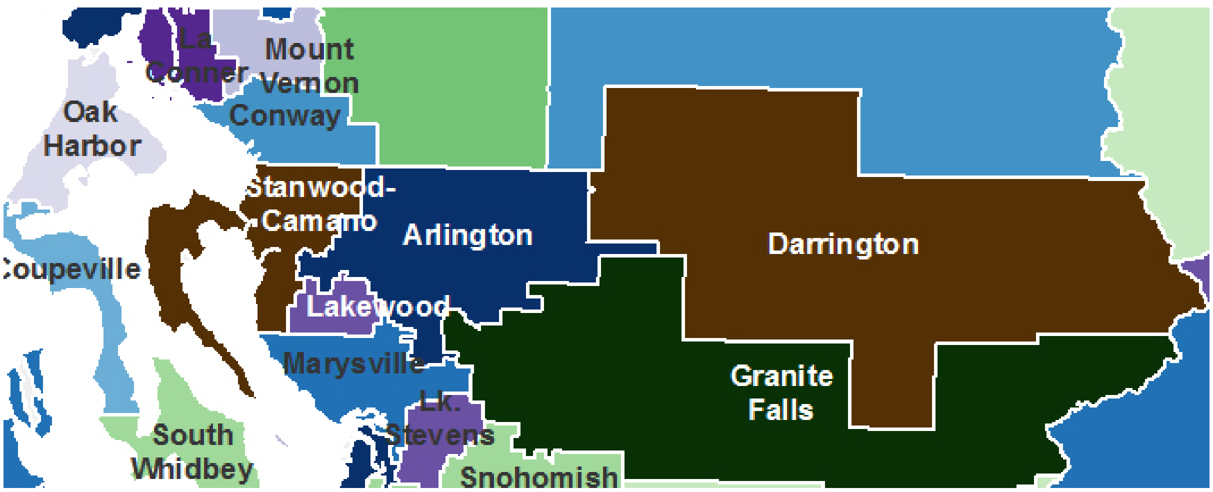
Chapter 6: Earthquakes
Chapter 7: Landslides

# 2.0 ARLINGTON PUBLIC SCHOOLS PROFILE

## 2.1 District Location

The Arlington Public Schools are located in Snohomish County on the I-5 corridor 45 miles North of Seattle next to the Cascade foothills.

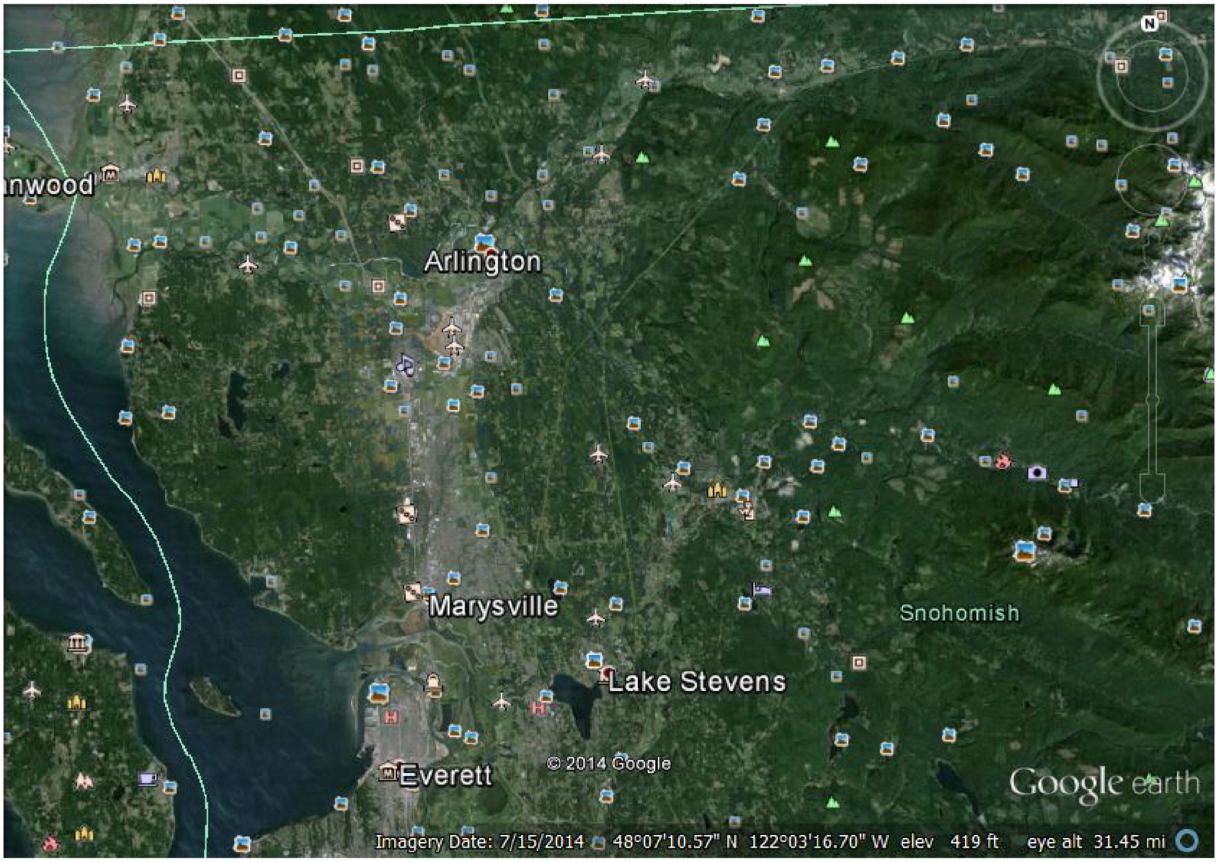
**Figure 2.1**
**Arlington Public Schools Map**




The Arlington Public Schools includes the city of Arlington, a section of Smokey Point and several unincorporated communities. The total population within the district's boundaries is approximately 30,062 as of 2013.

As shown in the Google Earth image in Figure 2.1 on the following page, the population within the Arlington Public Schools is located in North Snohomish County in an area between Puget Sound and the Cascade mountains.

**Figure 2.2**
**Arlington Public Schools and Vicinity**




## 2.2 District Overview

The City of Arlington is flanked by the Stillaguamish River with a history as a logging and agricultural area. Originally, there were two separate towns: Arlington and Haller City. Eventually, those who settled in Haller City moved to Arlington.

In 1884-1885, plans were made for the first school in the Arlington area. In 1885, the newly formed district was at Kent's Prairie. The original school building was made of cedar wood and Native Americans brought the flooring from Stanwood to Gifford's landing by canoe and then dragged by mules to the school. There were 12 Native American children and two Caucasian children when the school opened. In 1889, the school increased to 30 students.

Additional schools opened around 1887, including Trafton and Haller City. By 1894 the Lincoln school was added and started with two rooms before expanding to four rooms. In 1893, Garfield School was built and took the place of Kent's Prairie School. The first high school classes were held in the Garfield School in 1904-1905.

In 1904, Haller City District No. 50 and Arlington District No. 16 became School District No. 89 at the time the two cities incorporated. In 1908, $15,000 was voted for a new high school building with classes beginning on September 14, 1908. The new high school was named the Washington School. At the same time, the small neighboring schools from Edgecomb, Island, Trafton, Lake Riley, Ebey, Sisco Heights, Halterman, Greenwood, Oso, Cicero, Jordan, Jim Creek, Lower Pilchuck and Loyal Heights consolidated into the Arlington Public Schools.

Then in 1921, The Roosevelt School was built for the 4th through 12th grade students living in Arlington. The Roosevelt building is still in use for the district administration office. The Civilian Conservation Corps (CCC) opened a camp in Darrington in 1933 due to the loss of jobs when the mills closed down. The Works Progress Administration (WPA) built a new high school in 1936 along with sidewalks in the area. The high school is still being used by Arlington Public Schools and houses the maintenance, grounds, and food service departments.

Arlington Public Schools now has nine operating schools:  one high school, one alternative high school, two middle schools, four elementary schools and a parent-partner program. The district also includes an ECEAP preschool program at one of their elementary schools.

The Arlington Public Schools mission statement is:

> *Arlington Public Schools educates all students, preparing and inspiring them to achieve their full potential.*

**District Information**

| Position* | Count |
|---|---|
| Teachers | 296 |
| Para Educators | 77 |
| Other district staff | 182 |
| Total staff | 555 |
| ** School District November 2014* | |

| Grade Band* | Count |
|---|---|
| Preschool (Spec Ed & ECEAP) | 89 |
| Elementary school students | 2,363 |
| Middle school students | 1,291 |
| High school students | 1,789 |
| | |
| Total number of students | 5,532 |
| **School District November 2014* | |

| Ethnicity* | Count | Percentage |
|---|---|---|
| American Indian /Alaskan Native | 55 | 1.0% |
| Asian | 85 | 1.6% |
| Native Hawaiian / Other Pacific Islander | 29 | 0.5% |
| Asian / Pacific Islander | 114 | 2.1% |
| Black / African American | 65 | 1.2% |
| Hispanic / Latino of any race(s) | 623 | 11.4% |
| White | 4,340 | 79.6% |
| Two or more races | 253 | 4.6% |
| ** OSPI October 2013: http://www.k12.wa.us* | | |

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 Snohomish County because census data are not compiled for the district's specific boundaries. These data are approximately representative of those for Arlington Public Schools.

**Selected Demographic Data**
**Snohomish County**

| Population* | Number | Percent |
|---|---|---|
| Total | 745,913 | |
| Under 5 Years | 47,365 | 6.35% |
| Under 18 Years | 174,543 | 23.40% |
| 65 Years and Older | 87,272 | 11.70% |
| **2013 Estimate, State & County Quick Facts: www.census.gov* | | |

## 2.3 District Facilities

Arlington Public Schools has nine campuses and several other facilities including a district office building, Support Services and Transportation.

**Table 2.3**
**District Facilities**

| Arlington Pre-Disaster Mitigation Summary | | | | | | |
|---|---|---|---|---|---|---|
| **Campus/ Building** | **Building Condition** | **Floors** | **Building Area** | **Built** | **Sq. Ft** | **Structural Sys** |
| **Arlington High School** | | | | | | |
| Greenhouse | 99.50% Excellent | 1 | Area 1 | 2003 | 2,905 | S3 |
| Industrial Arts Building | 98.64% Excellent | 1 | Area 1 | 2003 | 11,750 | S3 |
| Main Building | 94.02% Good | 2 | Area 1 | 2003 | 241,526 | RM2L |
| Stadium | - | 2 | Area 1 | 2003 | 13,156 | RM1L |
| Stadium Storage | - | 1 | Area 1 | 2003 | 970 | RM1L |
| Stadium Ticket Booth | - | 1 | Area 1 | 2003 | 200 | RM1L |
| AF JROTC Portable | - | 1 | Area 1 | 1996 | 1,792 | MH |
| **Eagle Creek Elementary School** | | | | | | |
| Covered Play | 81.61% Fair | 1 | Covered Play | 1989 | 2,400 | C1L |
| Main Building | 80.56% Fair | 1 | Main Building | 1989 | 56,162 | RM1L |
| Metal Storage Building | - | 1 | Area 1 | 1989 | 864 | S3 |
| Portable 3 | - | 1 | Area 1 | 1998 | 896 | MH |
| Portable 4 | - | 1 | Area 1 | 1998 | 896 | MH |
| **Haller Middle School** | | | | | | |
| Gymnasium Building | 76.30% Fair | 1 | Gym | 1978 | 30,768 | RM1L |
| Hartz Field Bathroom and Storage Building | - | 1 | Area 1 | 1965 | 1,200 | RM1L |
| Hartz Field Concession Building | - | 1 | Area 1 | 1965 | 560 | W1 |
| Main Building | 99.61% Excellent | 2 | Main Building | 2006 | 48,845 | S2L |
| Music Building | 90.73% Good | 1 | Music/Art | 1968 | 6,390 | RM1L |
| **Kent Prairie Elementary School** | | | | | | |
| Covered Play | 87.28% Good | 1 | Area 1 | 1993 | 2,400 | C1L |
| Main Building | 83.59% Fair | 1 | Area 1 | 1993 | 56,162 | RM1L |
| **Pioneer Elementary School** | | | | | | |
| Main Building | 91.02% Good | 2 | Main | 2002 | 62,948 | S2M |
| **Post Middle School** | | | | | | |
| B Building - Gym | 61.18% Poor | 1 | Gym | 1981 | 16,740 | RM1L |
| Building A Main | 58.37% Poor | 1 | Main | 1981 | 44,921 | W2 |
| C Building - Art/Home Living/Woods | 56.58% Poor | 1 | Art/Woods/Home | 1981 | 6,640 | FLT |
| D Building Classrooms | 83.90% Fair | 1 | Classrooms | 1993 | 8,023 | FLT |
| Metal Storage (Senica) | - | 1 | Area 1 | 1981 | 1,200 | S3 |
| Portable 2 | - | 1 | Area 1 | 1999 | 896 | MH |
| Portable 3 | - | 1 | Area 1 | 1999 | 896 | MH |

| | | | | | | |
|---|---|---|---|---|---|---|
| Portable 4 | - | 1 | Area 1 | 1999 | 896 | MH |
| Portable 5 | - | 1 | Area 1 | 1999 | 896 | MH |

**Table 2.3 - Continued**
**District Facilities**

| Arlington Pre-Disaster Mitigation Summary | | | | | | |
|---|---|---|---|---|---|---|
| **Campus/ Building** | **Building Condition** | **Floors** | **Building Area** | **Built** | **Sq. Ft** | **Structural Sys** |
| **Presidents Elementary School** | | | | | | |
| Main Building | 95.54% Excellent | 2 | Area 1 | 2004 | 62,215 | S2L |
| **Trafton Elementary School** | | | | | | |
| Covered Play | 28.61% Unsatisfactory | 1 | Area 1 | 1965 | 700 | W1 |
| Main Building | 51.51% Poor | 2 | Area 1 | 1906 | 5,310 | W2 |
| **Weston High School** | | | | | | |
| Main Building | 81.31% Fair | 1 | Area 1 | 1978 | 33,323 | S4L |
| **"A" Building and District Storage** | | | | | | |
| Building "A" | - | 3 | Area 1 | 1936 | 70,991 | C1L |
| | | | Area 2 | 2005 | 2,640 | W1 |
| | | | Greenhouse | 1992 | 3,157 | S3 |
| Food Service Dry Storage Building | - | 1 | Area 1 | 1968 | 1,800 | RM1L |
| Grounds Department Storage Building | - | 1 | Area 1 | 1992 | 3,456 | W2 |
| **District Administration** | | | | | | |
| District Administration Office (Roosevelt) | - | 3 | Area 1 | 1940 | 21,402 | C1L |
| **Stillaguamish Valley School** | | | | | | |
| Portable 1 Office | - | 1 | Area 1 | 1999 | 1,792 | MH |
| Portable 10 | - | 1 | Area 1 | 1991 | 896 | MH |
| Portable 11 | - | 1 | Restrooms | 2001 | 300 | MH |
| Portable 2 | - | 1 | Area 1 | 1997 | 1,792 | MH |
| Portable 3 | - | 1 | Area 1 | 1997 | 1,792 | MH |
| Portable 4 | - | 1 | Area 1 | 2002 | 1,792 | MH |
| Portable 5 | - | 1 | Area 1 | 2001 | 1,792 | MH |
| Portable 6 | - | 1 | Area 1 | 1995 | 896 | MH |
| Portable 7 | - | 1 | Area 1 | 1997 | 896 | MH |
| Portable 8 | - | 1 | Area 1 | 1995 | 896 | MH |
| Portable 9 | - | 1 | Area 1 | 1995 | 896 | MH |
| **Transportation** | | | | | | |
| Pupil Transportation | - | 1 | Area 1 | 1973 | 12,320 | W2 |

During the 2013-2014 school year, a Master Facilities Committee was formed to review the status of the current facilities and district-owned properties. The membership of this committee consisted of an architect, facilities consultant, district employees and community members. The Committee made several determinations regarding these properties and presented them to the board. One of the recommendations that applies to this document is the replacement of Post Middle School which could, in effect, be rebuilt away from the adjacent slope and improve its earthquake and landslide resiliency. Plans are in the works to present a bond to the community part of which is to request funds to replace the current Post Middle School structure.

Following are pictures of the facilities referred to in table 2.3.

Arlington High

Byrnes Performing Arts

Weston High

Haller Middle

Post Middle

Eagle Creek Elementary

Kent Prairie Elementary

Pioneer Elementary

Presidents Elementary

Stillaguamish Valley School

Roosevelt Building Administrative Offices

# 3.0 MITIGATION PLANNING PROCESS

## 3.1 Overview

The Arlington Public Schools' mitigation planning process began in the fall of 2013. The District's mitigation plan is consistent with, and draws extensively from, the Washington State K–12 Facilities Hazard Mitigation Plan. However, the Arlington Public Schools' 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 Emergency Management and Response Team (EMART) from the Arlington Public Schools was accessed as The Mitigation Planning Team for this process. This team consists of representatives from district and building leadership as well as local law enforcement and fire department. EMART meets monthly to review, discuss, plan, and implement best practices when responding to disaster/emergency situations that occur in the educational setting. EMART is co-led by the Director of Support Services and Executive Director of Operations**.**

2014-15 EMART Roster

| | |
|---|---|
| Stephanie Ambrose | School Resource Officer, Arlington Police Department |
| Ed Aylesworth | Director, Child Nutrition and Support Services |
| Alan Boatman | Assistant Principal, Arlington High School |
| Deb Borgens | Executive Director, Finance |
| Andrea Conley | Public Information Officer, Arlington Public Schools |
| Tom Cooper | Acting Chief, Arlington Fire Department |
| Mischelle Darragh | Assistant Principal, Post Middle School |
| Gloria Davis | Registered Nurse, Arlington Public Schools |
| Eric DeJong | Principal, Haller Middle School |
| Joseph Doucette | Principal, Stillaguamish Valley School |
| Tammy Duskin | Certificated Staff, Haller Middle School |
| Kari Henderson-Burke | Principal, Eagle Creek Elementary |
| Kerri Helgeson | Principal, Pioneer Elementary |
| Sid Logan | Executive Director, Operations |
| Dave McKellar | Principal, Presidents Elementary |
| Karl Olson | Principal, Kent Prairie Elementary |
| Charity Prueher | Assistant Supervisor, Transportation |

2015-16 EMART Roster

| | |
|---|---|
| Stephanie Ambrose | School Resource Officer, Arlington Police Department |
| Ed Aylesworth | Director, Child Nutrition and Support Services |
| Alan Boatman | Assistant Principal, Arlington High School |
| Deb Borgens | Executive Director, Finance |
| Andrea Conley | Public Information Officer |
| Tom Cooper | Acting Chief, Arlington Fire Department |
| Mischelle Darragh | Assistant Principal, Post Middle School |
| Gloria Davis | Registered Nurse, Arlington Public Schools |
| Adele Barbarinas | Assistant Principal, Haller Middle School |
| Joseph Doucette | Principal, Stillaguamish Valley School |
| Bethany Belisle | Assistant Principal, Eagle Creek Elementary |
| Kim Caldwell | Assistant Principal, Pioneer Elementary |
| Sid Logan | Executive Director, Operations |
| Derek Larsen | Assistant Principal, Presidents Elementary |
| Colleen Van Belle | Assistant Principal, Kent Prairie Elementary |
| Charity Prueher | Assistant Supervisor, Transportation |
| Will Nelson | Principal, Weston High School |

2016-17 EMART Roster

| | |
|---|---|
| Mike Gilbert | School Resource Officer, Arlington Police Department |
| Ed Aylesworth | Director, Child Nutrition and Support Services |
| Alan Boatman | Assistant Principal, Arlington High School |
| Deb Borgens | Executive Director, Finance |
| Gary Sabol | Public Information Officer |
| Tom Cooper | Deputy Chief, Arlington Fire Department |
| Paul Dobberfuhl | Assistant Principal, Post Middle School |
| Gloria Davis | Registered Nurse, Arlington Public Schools |
| Sally Schroeder | Assistant Principal, Haller Middle School |
| Joseph Doucette | Principal, Stillaguamish Valley School |
| Bethany Belisle | Assistant Principal, Eagle Creek Elementary |
| Kim Caldwell | Assistant Principal, Pioneer Elementary |
| Brian Lewis | Executive Director, Operations |
| Jamie Miller | Assistant Principal, Presidents Elementary |
| Colleen Van Belle | Assistant Principal, Kent Prairie Elementary |
| Charity Prueher | Assistant Supervisor, Transportation |
| Will Nelson | Principal, Weston High School |

For the purposes of developing the Pre-disaster mitigation project, EMART's role 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 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 Arlington Public Schools Hazard Mitigation Plan.

## 3.3 Mitigation Planning Team Meetings

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

**March 16, 2015 EMART Meeting-1st review of pre-mitigation plan draft**

Members Present: Ed Aylesworth, Sid Logan, Dave McKeller, Gloria Davis, Erik Heinz for Alan Boatman), Tammy Duskin, and Karl Olson

Members Absent: Stephanie Ambrose, Alan Boatman, Deb Borgens, Andrea Conley, Tom Cooper, Mishelle Darragh, Eric DeJong, Joseph Doucette, Tammy Duskin, Kari Henderson-Burke, Kerri Helgeson, Charity Prueher

1. Discuss Pre-mitigation plan draft review. Reviewed chapters 1-5
    a. All agreed to the mission statement.
    b. Ed explained the purpose of the plan.
    c. Discussed the risk for all events for each school.
    d. Reviewed the condition values for all buildings, several questions for Ed to research before final version.
    e. Add Tammy Duskin to EMART roster in chapter 3
    f. Discussed ways in which we could have public involvement.
    g. Reviewed the goals of the plan in chapter 4.
    h. Reviewed action items in chapter 4.
    i. For earthquake action item add "as funds are available" before ASCE 41-13

j. For landslide action item #1 remove Kent Prairie
k. Reviewed chapter 5
l. Ed asked the group to review the earthquake and landslide chapters for discussion at the next meeting.

**November 19, 2015 EMART meeting**, 2nd review of Pre-Mitigation Plan draft

Members present: Ed Aylesworth, Sid Logan, Kim Caldwell, Colleen Van Belle, Alan Boatman, Andrea Conley, Stephanie Ambrose, Derek Larsen, Deb Borgens, Bethany Belisle, Joseph Doucette, Adele Barbarinas, Will Nelson

Members absent: Tom Cooper, Gloria Davis, Charity Prueher, Mishelle Darragh

Drafts of the 6th and 7th chapters (earthquake and landslides) had been put on a Google File for review by the members. Since many members are new to the committee this year, Ed provided an overview of the project as well as the chapters to be reviewed next. No decisions were made regarding the Pre-Mitigation plan at this time. The committee will review the chapters before the next meeting December 17, 2015.

**December 17, 2015 EMART meeting**, 3rd review of Pre-Mitigation Plan draft.

Members present: Ed Aylesworth, Alan Boatman, Andrea Conley, Joseph Doucette, Derek Larsen, Sid Logan, Will Nelson, Colleen Van Belle

Members absent: Stephanie Ambrose, Deb Borgens, Tom cooper, Mischelle Darraugh, Gloria Davis, Adele Barbarinas, Bethany Belisle, Kim Caldwell, Charity Prueher.

Review, discuss, and approve emergency protocols, Chapters 6 & 7 and pre-mitigation manual, and classroom emergency chart. Mitigation Committee needs to be a diverse group of people to go through documents, have a public meeting, and present to board. This allows us to get assistance from FEMA earlier due to preparedness.

- Mitigation: 6.0 Earthquakes - Approved
  - Structural Engineer deemed WHS not high as an earthquake hazard. It should be noted.
  - Need to look at high hazard/high risk.
- Mitigation: 7.0 Landslides – Approved

## 3.4 Public Involvement in the Mitigation Planning Process

The District took steps to involve the public and stakeholders throughout the mitigation planning process, including the following actions:

### Notices

The District announced the request for public review of the Pre-Mitigation Plan via:

- Posting a notice on the District's website,
- Distributing the notice via e-mail to a wide audience of stakeholders including the following:

| | |
|---|---|
| Arlington Fire Department | Assistant Fire Chief |
| Arlington Police Department | School Resource Officer |
| Arlington Smokey Point Chamber of Commerce | Executive Director |
| City of Arlington | Permit Center Manager |
| City of Arlington- Planning and Land Use | Associate Planner |
| City of Marysville | Risk/Emergency Manager |
| Darrington School District | Business Manager |
| Granite Falls School District | Director of Business/Operations |
| Lake Stevens School District | Executive Director of Operations |
| Lakewood School District | Facilities Supervisor |
| Marysville School District | Facilities Supervisor |
| Marysville School District | Risk Manager |
| OSPI School Facilities and Organization | Program Development Manager |
| Snohomish County Emergency Management | Director |
| Snohomish County Emergency Management | Program Manager - UASI/ HLS Region I Coordinator |
| Snohomish County Emergency Management | Preparedness and Mitigation Program Manager |
| Snohomish County Planning and Development Services | Director |
| Snohomish County Red Cross | Executive Director |
| Stanwood School District | Executive Director of Business Services |
| Stillaguamish River Clean Water District | Senior Planner |
| Stillaguamish Tribes | Planning Department |
| Stillaguamish Tribes | Facilities |
| Washington Emergency Management Division | Hazard Mitigation and Recovery Strategist |
| Everett Community College | Director of Facilities and Grounds |

- Publishing the notice in the following local newspaper(s):
  - Everett Herald.

Copies of the above notices are included in Appendix C.

### Public Meetings

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

- Meeting 1
    - January 9, 2017-initial presentation to the School Board of Directors

  During this meeting, the Director of Support Services presented the plan to the School Board of Directors. Discussion ensued and next steps in the process outlined for the board.

- Meeting 2
    - February 7, 2017 public opportunity for comment in the Lincoln Room at District Office

    No one from the community attended this meeting.

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

### Review and Comment on Mitigation Plan Drafts

Mitigation plan drafts were posted on the District's website for review. Notices of the District's requests for comments being solicited from all interested parties were made via the Everett Herald, Arlington Public Schools website, and email to specific entities. Copies of the notices are included in Appendix C.

Key inputs received during the review and comment periods included the following:

- Great job xxxx, thanks!
- This appears to be a complete and comprehensive plan. I did not find any errors, however I did not read the entire document word for word.
- Hazards: Page 199. Should there be some disclaimer indicating that the ASD has **attempted** to identify major natural disasters to the best of our knowledge (RE: The Arlington Public Schools Hazard Mitigation Plan covers each of the major natural hazards that pose significant threats to the District) rather than suggesting that we have addressed them all?…..
- Table 1.7. Just wondering why PMS would be a risk for landslide and AHS would not? Both adjacent to ravines.
- Goal 4: Page 228. Why is the resource maintained at the AHS Library?
- Page 230: complete headers on table 4.1 are not visible.
- Page 269: Links appear incorrect or outdated.
- Page 269: 2013 updated version available: http://www.crew.org/sites/default/files/cascadia_subduction_scenario_2013.pdf

- Wondering why "The Watershed Company.  July 2010.  DRAFT Shoreline Analysis Report for the City of Arlington's Shoreline: South Fork and Mainstem Stillaguamish River and Portage Creek.  Prepared for the City of Arlington, Arlington, WA" not a cited reference?  Seems relevant. (Final version available here)
- I may have missed it, but is one of our action plans to team with the City (and county, and hospital if relevant) in community education and outreach?

- Table 6.3, page 263. Display issues.

Changes to the document were made according to the suggestions noted through public comment as appropriate.

- A sentence was included to address the comment that this Hazard Mitigation Plan focuses only upon identified natural disasters
- An explanation of why Arlington High School is not of concern for landslide was added
- The reason for including these resources at Arlington High School was added
- Formatting and updating issues were corrected

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

The Arlington Public Schools 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 (OSPI) Inventory and Condition of Schools (ICOS) 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 Geographic Information Systems (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.

Weston High School structural plans were reviewed and a walk-through conducted by a structural engineering firm December, 2014.  The engineers determined that "the building structure is a pre-engineered steel building with tilt-up panels around the perimeter" and that "In general the building's lateral force resisting system meets the intent of the current building code requirements." As a result, the Weston High School building is determined to be less of a risk and will not be as high a priority as compared to Post Middle School. A copy of the Engineer's letter follows:

www.pcs-structural.com

December 23, 2014

Arlington School District
315 North French Avenue
Arlington, WA 98223

ATTN: Sid Logan

RE: *Weston High School Walkthrough*

Dear Sid:

Per your request, I joined Fred Owyen and yourself on a walkthrough of Weston High School in the Arlington School District. The purpose of this walkthrough was to review the existing structural system to determine the structures ability to resist earthquake loads.

During the walkthrough it was determined that the building structure is a pre-engineered steel building with concrete tilt-up panels around the perimeter. The building was determined to be constructed in 1978.

The lateral force resisting system for the building consists of steel moment resisting frames in the transverse direction and concrete tilt-up shear walls in the longitudinal direction. In general the building's lateral force resisting system meets the intent of the current building code requirements.

Thank you for the opportunity to be of continued service to the Arlington School District. Please contact us if you have any questions.

Very truly yours,

PCS STRUCTURAL SOLUTIONS

Donald R. Scott, S.E., F.SEI
Vice President / Director of Engineering

DRSmao
15-109

cc: Fred Owyen – Owyen Consulting

DONALD R. SCOTT
STATE OF WASHINGTON
22917
STRUCTURAL ENGINEER
PROFESSIONAL ENGINEER

15109 ltr 12-23-14 drs

It was noted that Post Middle School is located near a steep slope. A Geotechnical Company was contracted to complete a surficial observation of the site to determine current status of the site for landslide potential. Their findings are outlined in the following letter beginning on the next page.

**NELSON GEOTECHNICAL ASSOCIATES, INC.**
**GEOTECHNICAL ENGINEERS & GEOLOGISTS**

Main Office
17311 – 135th Ave NE, A-500
Woodinville, WA 98072
(425) 486-1669 · FAX (425) 481-2510

Engineering-Geology Branch
5526 Industry Lane, #2
East Wenatchee, WA 98802
(509) 665-7696 · FAX (509) 665-7692

# MEMORANDUM

DATE: February 6, 2014

TO: Fred Owyen – Owyen Consulting, LLC

FROM: Khaled M. Shawish, P.E.
Lee S. Bellah, LG

RE: Geotechnical Engineering Consultation
Post Middle School
1220 East 5th Street
Arlington, Washington
NGA File No. 889014

KHALED M. SHAWISH
STATE OF WASHINGTON
35215
REGISTERED
PROFESSIONAL ENGINEER
EXPIRES 7/28/15

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## Introduction

This memorandum documents our surficial observations and preliminary opinions regarding the steep slope conditions at the Post Middle School property located at 1220 East 5th Street in Arlington, Washington. We understand that some concerns regarding the stability of a steep slope to the northeast of the school have been raised and you have requested that we visit the site and provide general opinions regarding the conditions of the steep slope based on surficial observations. This is not an in-depth evaluation of the property, as no subsurface explorations or engineering analysis were performed.

## Site Geology

**Geology:** The Geologic Map of the Arlington East Quadrangle, Snohomish County, Washington, by James P. Minard (U.S.G.S., 1985) was referenced for the geologic conditions at the site. The site is mapped as the Arlington Gravel Member of the Recessional Outwash deposits (Qvra) and Glacial Till (Qvt). The Arlington Gravel deposit consists of sand and gravel. Glacial till in this area consists of a dense, nonsorted mixture of clay, silt, sand, and gravel. We observed exposures within the steep slope generally consisted of sand and gravel soils underlain by silty fine to medium sand with gravel soils consistent with the description of the Recessional Outwash deposit and Glacial Till, respectively.

## Observations

We visited that site on January 14, 2014 to perform a walk through evaluation of the steep slope area and observe surficial conditions. The site is currently occupied by an existing school building within the relatively level, central portion of the property. A steep slope is located to the northeast of the school building with an existing access driveway between the steep slope and the school building. The top of the steep northeast-facing slope is located approximately 14 to 30 feet from the eastern edge of the access driveway. The school building is setback approximately 51 to 87 feet from the top of the steep slope. The slope descends down from the relatively level upper area to a pond area below at approximate gradients in the range of 30 to 75 degrees (58 to 373 percent). The overall slope height is roughly 60 to 70 feet.

We observed soil exposures immediately below the top of the bluff consisting of granular soils interpreted to be recessional outwash deposits underlain by siltier glacial till. The slope is generally well vegetated with young to mature trees, grass and underbrush. We observed some minor shallow surficial sliding and erosion immediately below the top of the slope. Some of these shallow failures appear to have undermined some of the larger trees on the slope. We also did not observe any recent signs of large deep-seated instability of the site slopes within the property.

We did not observe groundwater emitting from the slope face immediately below the top of the slope, however we did observe evidence of outcropping groundwater on the slope. We anticipate that some of the groundwater within this site could daylight on the slope in the form of perched groundwater. Perched water occurs when surface water infiltrates through less dense, more permeable soils and accumulates on top of the underlying, less permeable soils. The more permeable soils consist of the outwash sands. The less permeable soils consist of the underlying glacial till. Perched water does not represent a regional ground water "table" within the upper soil horizons. Perched water tends to vary spatially and is dependent upon the amount of rainfall. We would expect the amount of ground water to decrease during drier times of the year and increase during wetter periods.

## Preliminary Opinions and Recommendations

Based on our surficial evaluation of steep slope area to the northeast of the school building, it is our opinion that the steep slope area appears to be generally stable with respect to deep-seated movement.

However, there is a potential for shallow sloughing and erosion events to continue to occur on the steeper portions of the slope as we observed during our site visit. Surface erosional activity is considered common to these types of slopes, which is generally caused by seasonal saturation of the near-surface soils, oversteepening of the native slopes by natural weathering processes (wind, rain, freeze-thaw), and by local groundwater seepage. Due to the steep conditions, underlying soils, erosion and weathering conditions, and the potential of groundwater seepage, the surface soils are considered to be at risk for downslope movement associated with steep slopes within the area which was indeed observed on the site slopes during our site visit. Based on our observations, it is our opinion that the site is not backwasting significantly at this time, but we would anticipate that during periods of extended rainfall and/or as a result of seismic activity, shallow slides and surface erosion could occasionally occur on the steep slopes within this area. This condition can be exacerbated by allowing surface water to flow over the top of slope, and over-steepening caused by erosion and surface sliding.

It is our opinion that some of the trees within the steep slope have been undermined and could pose a hazard to slope stability. We recommend that a certified arborist be retained to evaluate the condition of the existing trees on the steep slope and provide their opinions and recommendations regarding tree management on the slope. At a minimum, we recommend that the undermined trees be cut down near the ground surface and their stumps left in place. No debris from tree removal should be allowed to remain in the steep slope area. Care should also be taken to no impact slope stability conditions on the slope during tree removal. If any areas are disturbed, they should be compacted and covered with erosion control material. Disturbed areas should be planted as soon as practical and the vegetation should be maintained until it is established.

Based on our recent surficial observations it appears that the school building setback is adequate at this time. We understand that the existing school building may be remodeled or replaced entirely in the future. If the school building is to remain and be remodeled, we recommend that stormwater runoff from the school and the existing access driveway along the top of the steep slope be controlled to flow away from the steep slope area. If the existing school is to demolished and a new building constructed, we recommend that we be retained to explore the subsurface conditions throughout the site with deep explorations, and provide a geotechnical evaluation to confirm the proposed setback and provide our opinions and recommendations regarding overall stability of the slope, foundations, drainage and erosion control for the project. No material or structures of any kind should be placed on the steep slope or along the top of the slope without a specific in-depth geotechnical evaluation. We recommend that the existing access roadway and the top of slope be monitored by school staff, especially during periods of heavy precipitation, for any signs of failures and we be notified to provide an assessment should such signs be observed.

## Closure

The opinions and recommendations expressed above are based on limited surficial observations of the steep slope area and are only intended to point out potential concerns with the property. These are not design-level recommendations and should not be used by you or a potential contractor or designer unless a further and specific evaluation is conducted. A more thorough understanding of the subsurface soil and groundwater conditions as well as the stability of the site slopes will require subsurface explorations, mapping, and engineering analysis. The City of Arlington will likely require a geotechnical evaluation of the property prior to issuing construction permits for any future development plans.

Future development plans for the site and long-term maintenance will also have an impact on the site stability and such plans should not be carried out without an engineering evaluation and City of Arlington approval. No other warranty, expressed or implied, is made. Our observations, findings, and opinions are a means to identify the inherent risks to the owner.

We trust this memorandum should satisfy your needs at this time. Please contact us if you have any questions or require additional services.

o-O-o

Based upon this information, a certified arborist was retained to evaluate the trees above the slope. The arborist's findings follow.

From: Thomas Boyce / ISA Certified Arborist PN 6183
12227 Huckleberry Lane
Arlington WA 98223
360 4355935
To: Arlington School District

Date: August 5, 2014

Re: Trees at Post Middle School

I was contacted by Ed Aylesworth in my capacity as a Certified Arborist to assess a stand of trees in the north perimeter of Post Middle School grounds. I looked at the same trees in this area with Sid Logan four years ago . The number a failing trees has increased since then.

These trees are growing on the top of a narrow and extremely steep slope that is slowly eroding. Healthy trees are essential in retaining the soil structure in this currently compromised area. However there are many dead and dying trees in this stand. Removing the dead trees would take a lot of weight off of this bluff to prevent any loss of stability. Most of the dead or dying trees are Western Red Cedars (Thuja plicata) . There a many healthy Cedars that should remain intact. There are also Douglas Firs (Pseudotsuga menzesii) that are in obvious decline as well. Some younger trees have grown in this area that should not be removed.

On the steep slope below there is evidence of recent soil movement . There is no new plant growth in this area. The loss of soil is undermining and exposing the roots of a number of trees noticeably affecting their stability and health. The trees with exposed roots hanging over the slope should be removed. There is evidence ( trunk curvature) of soil creep meaning that the a tree leaned with the moving soil and corrected to its trunk growth to straight over time.The majority of the tree species to be removed on the slope are Big Leaf Maples that when cut down will resprout new branches from the stump allowing the tree roots to help in soil stabilization. Eliminating the large tree on this slope will substantially reduce the force of the weight on this slope.

The first priority is to remove the already failing trees. Replanting of smaller growing trees and shrubs is recommended in this situation. Because these failing trees are within striking distance of the school building and grounds, removal should be considered for safety concerns to students and school staff.

Respectfully submitted,

Thomas Boyce

Consulting Arborist

The Arlington Public Schools regularly practice drills per state law. EMART reviewed and up-dated the procedures for earthquake response in 2014 and have been implemented in drills including the Great Washington Shakeout each year. First responders regularly participate in drills and have provided training for Search and Rescue.

The Arlington Public Schools has also designated Haller Middle School and Presidents Elementary for use by the Snohomish County Health Department as needed for services to the community such as mass inoculations.

The Master Facilities planning committee completed a study of assets in the district in 2014. Part of the recommendation to the school board is to replace Post Middle School which will bring it up to earthquake code and potentially mitigate landslide concerns by locating the building further from the adjacent slope. Currently, Arlington Public Schools has reconvened the Facilities Advisory Committee and is in process of up-dating the Study and Survey for purposes of analyzing the condition of all the buildings in the district in preparation for presenting a bond request to the voters in the district.

# 4.0 GOALS, OBJECTIVES, AND ACTION ITEMS

## 4.1 Overview

The purpose of the Arlington Public Schools 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 Arlington Public Schools 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 Arlington Public Schools 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 Arlington Public Schools toward a safer and more disaster resistant future.

The Arlington Public Schools 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 Arlington Public Schools 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 Arlington Public Schools 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 Arlington Public Schools 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 Arlington Public Schools Hazard Mitigation Plan is to:

> **Proactively facilitate and support district-wide policies, practices, and programs that make the Arlington Public Schools more disaster resistant and disaster resilient.**

Making the Arlington Public Schools 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 Arlington Public Schools'. These goals were developed with extensive input and priority setting by the Arlington Public Schools' hazard mitigation planning team, with input 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 Arlington Public Schools.

**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 disaster evacuation plans and conduct frequent practice drills. When evacuation is impossible in the anticipated warning time, consider 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, 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 Arlington Public Schools, 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 in order to provide access to hazard information to high school students.

## 4.4 Arlington Public Schools 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 Arlington Public Schools' Hazard Mitigation Plan Action Items are summarized on the following tables.

**Table 4.1**
**Arlington Public Schools Mitigation Action Items**

| Hazard | Action Item | Timeline | Source of Funds | Responsible Party | Plan Goals Addressed | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Life Safety | Protect Facilities | Enhance Emergency Planning | Enhance Awareness |
| **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 4.2**
**Arlington Public Schools 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 | Evaluate the Seismic vulnerability of the buildings identified by the preliminary screening as likely being at moderate to high risk by having an engineer complete ASCE 41-13 Tier 1 screenings for all or a prioritized subset of these buildings. Order of priority would be Post, Eagle Creek, Kent Prairie, Weston, Transportation and A Building. | 1-2 Years | District or Grant | Supt. | X | X | | X |
| Short Term #2 | 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 Grant | Supt. | X | X | | X |
| Short Term #3 | Evaluate the foundations of the portable buildings to determine whether they are adequate for earthquakes. | 1-3 Years | District or Grant | Supt. | X | X | | X |
| Long Term #1 | Prioritize and implement seismic retrofits or replacements based on the results of the above detailed evaluations, as funding becomes available. | Ongoing | District or Grant | 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 Grant | Supt. | X | X | | X |
| Long Term #3 | Enhance emergency planning for earthquakes including duck and cover and evacuation drills | Ongoing | District or Grant | Supt. | X | | X | X |

**Table 4.3**
**Arlington Public Schools 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 |
| **Landslide Mitigation Action Items** | | | | | | | | |
| Short-Term #1 | Consult with a geologist or geotechnical engineer regarding possible landslide risk from the steep slopes on the east side of the Post Middle School and south side of the Kent Prairie Elementary School. | 1-2 Years | District or Grants | Supt. | **X** | **X** | **X** | **X** |
| Long-Term #1 | Evaluate possible mitigation measures if the study (short term #1) deems the risk significant at either campus. | 1-2 Years | District or Grants | Supt. | **X** | **X** | **X** | **X** |

# 5.0 MITIGATION PLAN ADOPTION, IMPLEMENTATION AND MAINTENANCE:

## 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 Arlington Public Schools 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 Arlington Public Schools has adopted, and will implement and maintain, the vitality of the District's Hazard Mitigation Plan.

## 5.2 Plan Adoption

This is the Arlington Public Schools' first Hazard Mitigation Plan which became effective on May 8, 2017, the date of adoption by the Arlington Public Schools 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.

ARLINGTON
Public Schools

**RESOLUTION NO. 17-06**
*Adoption of the Arlington Public Schools Hazard Mitigation Plan*

WHEREAS, Arlington Public Schools 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, Arlington Public Schools 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 that the Arlington Public Schools Board of Directors adopts the 2017 Arlington Public Schools Hazard Mitigation Plan.

Adopted by the Arlington Public Schools Board of Directors on the 8th day of May, 2017.

ARLINGTON PUBLIC SCHOOLS BOARD OF DIRECTORS:

Jeff Hulcott
President

Vice President

Kay Dodson
Member

Member

Member

ATTEST:

Chrys Sweeting
Secretary to the Board

## 5.3 Implementation

The Executive Director of Operations will have the lead responsibility for implementing the Arlington Public Schools Hazard Mitigation Plan with ongoing support from EMART and the Facilities Committee as needed.

### 5.3.1 Existing Authorities, Policies, Programs, Resources and Capabilities

The Arlington Public Schools 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 Arlington Public Schools 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 Arlington Public Schools has the necessary human resources to ensure that the Arlington Public Schools 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 Arlington Public Schools 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 Arlington Public Schools 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

**Administrative Tools (Departments, Organizations, Programs)**

Arlington Public Schools Resources

- School Board
- Superintendent
- ACE committee
- EMART

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
- Snohomish County, including Emergency Management, Public Works and GIS, Planning Department and Building Officials.
- City of Arlington including Emergency Management, Public Works and GIS, Planning Department and Building Officials
- Arlington Fire Department

- Arlington Police Department

**Other Technical Tools (Plans and Others)**

Arlington Public Schools Capabilities

- District Website
- School Closure Telephone Plan
- Evacuation Plan
- Lockdown Plan
- 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 Safety Plan

Regional Capabilities

- Snohomish County Hazard Mitigation Plan and Emergency Response Plan
- City of Arlington Hazard Mitigation Plan and Emergency Response Plan

**Fiscal Tools (Taxes, Bonds, Funds and Fees)**

Arlington Public Schools Capabilities

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

  - Debt Service Fund
  - Transportation Vehicle Fund
  - Trust Fund
  - Booster Funds
- External Funds
  - OSPI  School Construction Assistance Program Modernization / New in Lieu
  - FEMA Grants
  - HUD "CDBG" Grants
  - Foundation Grants
  - Legislative Funding/Grants

### 5.3.2 Integration into Ongoing Programs

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

The Arlington Public Schools prioritization of mitigation projects will include the following factors:

1. The mission statement and goals in the Arlington Public Schools 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 Arlington Public Schools 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 Arlington 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 Arlington Public Schools 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 Arlington 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 Executive Director of Operations, will have the lead responsibility for implementing the Arlington Public Schools 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 Arlington Public Schools 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 Arlington Public Schools, such as vulnerabilities to earthquakes?
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.

EMART and/or the Facilities Advisory Committee will review the results of these mitigation plan assessments, identify corrective actions and make recommendations, if necessary, to the Arlington 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.

EMART 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 Arlington Public Schools 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 Arlington and Snohomish County.

The 2016 the Arlington Public Schools Hazard Mitigation Plan will be available on the District's website and hard copies will be placed in the school offices. 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 Arlington Public Schools 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 input is deemed necessary. The press release will direct people to the website and other locations where the public can review proposed updated versions of the Arlington Public Schools 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]**

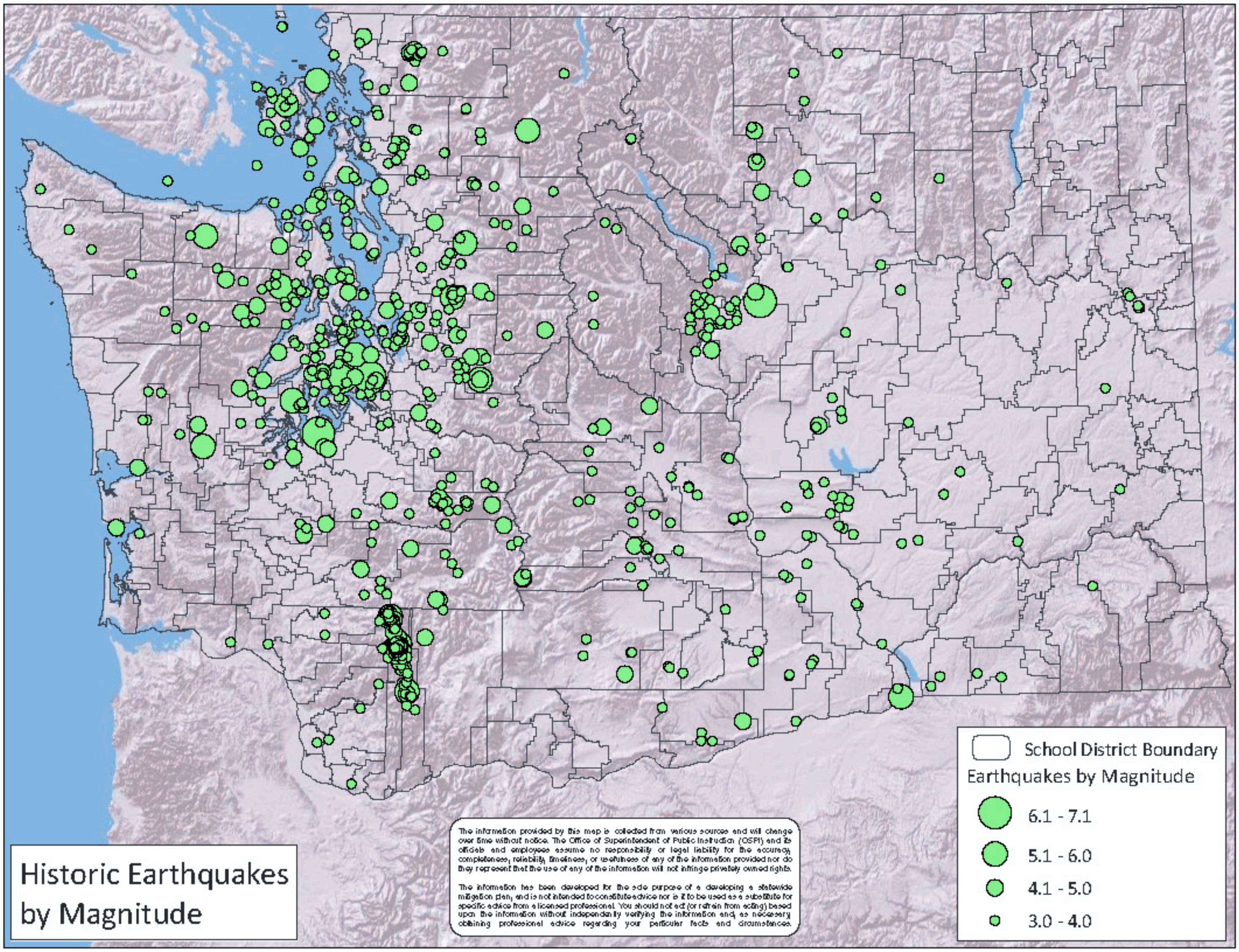


Table 6.1 and Figure 6.1 do not include the January 26, 1700 earthquake on the Cascadia Subduction Zone which has been identified by tsunami records in Japan and paleoseismic investigations along the Washington Coast. The estimated magnitude of the 1700 earthquake is approximately 9.0. This earthquake is not shown in Table 6.1 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:

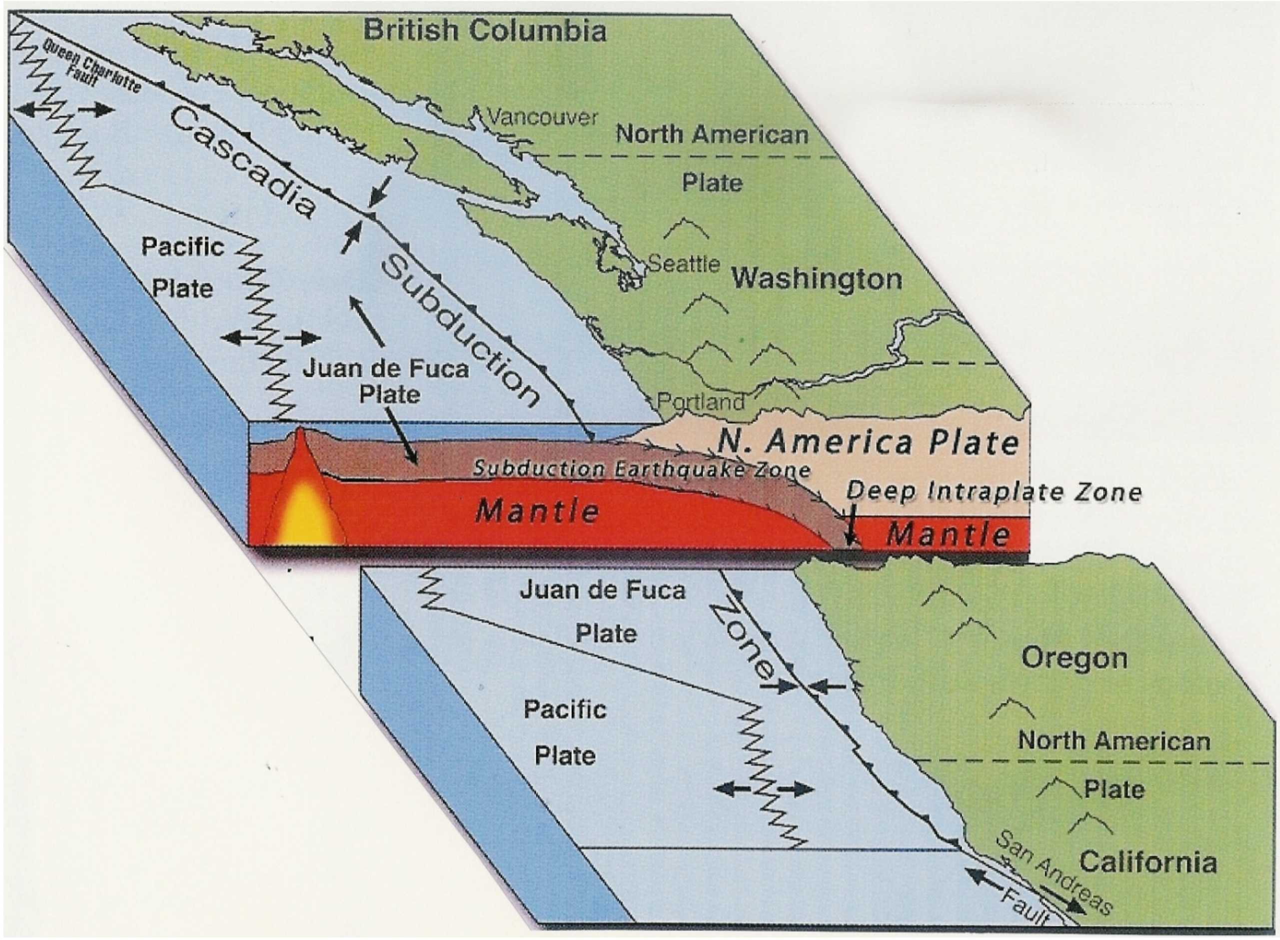
1) "Interface" earthquakes on the boundary between the subducting Juan de Fuca Plate and the North American Plate,

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.

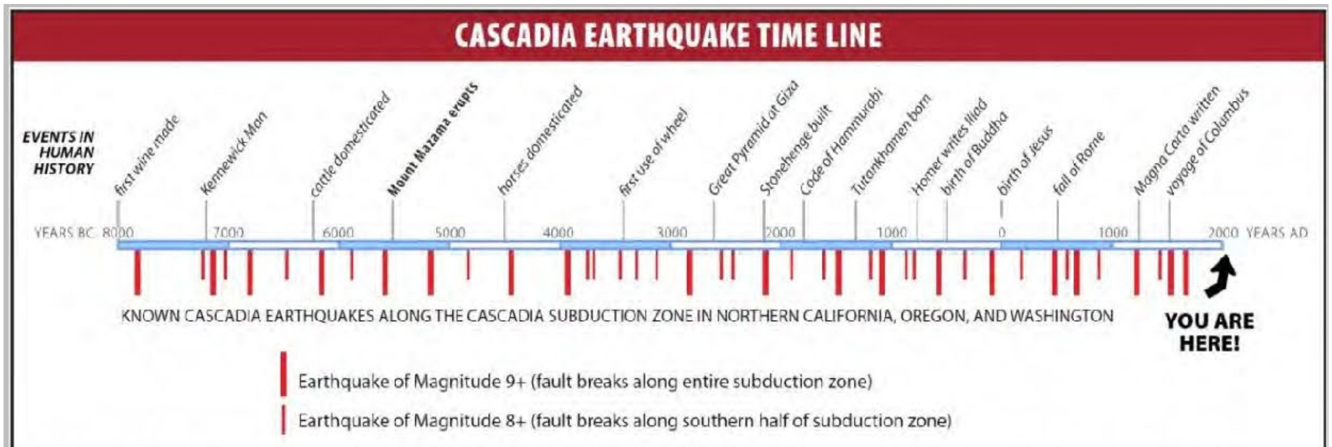
**Figure 6.2**
**Cascadia Subduction Zone**[4]




Paleoseismic 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.

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



**Comparison of the history of subduction zone earthquakes along the Cascadia Subduction Zone in northern California, Oregon, and Washington, with events from human history. Ages of earthquakes are derived from study and dating of submarine landslides triggered by the earthquakes. Earthquake data provided by Chris Goldfinger, Oregon State University; time line by Ian P. Madin, DOGAMI.**

"Intraplate" earthquakes occur within the subducting Juan de Fuca Plate. These earthquakes may have magnitudes up to about 6.5, 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 de-amplify 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 Arlington Public Schools 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**

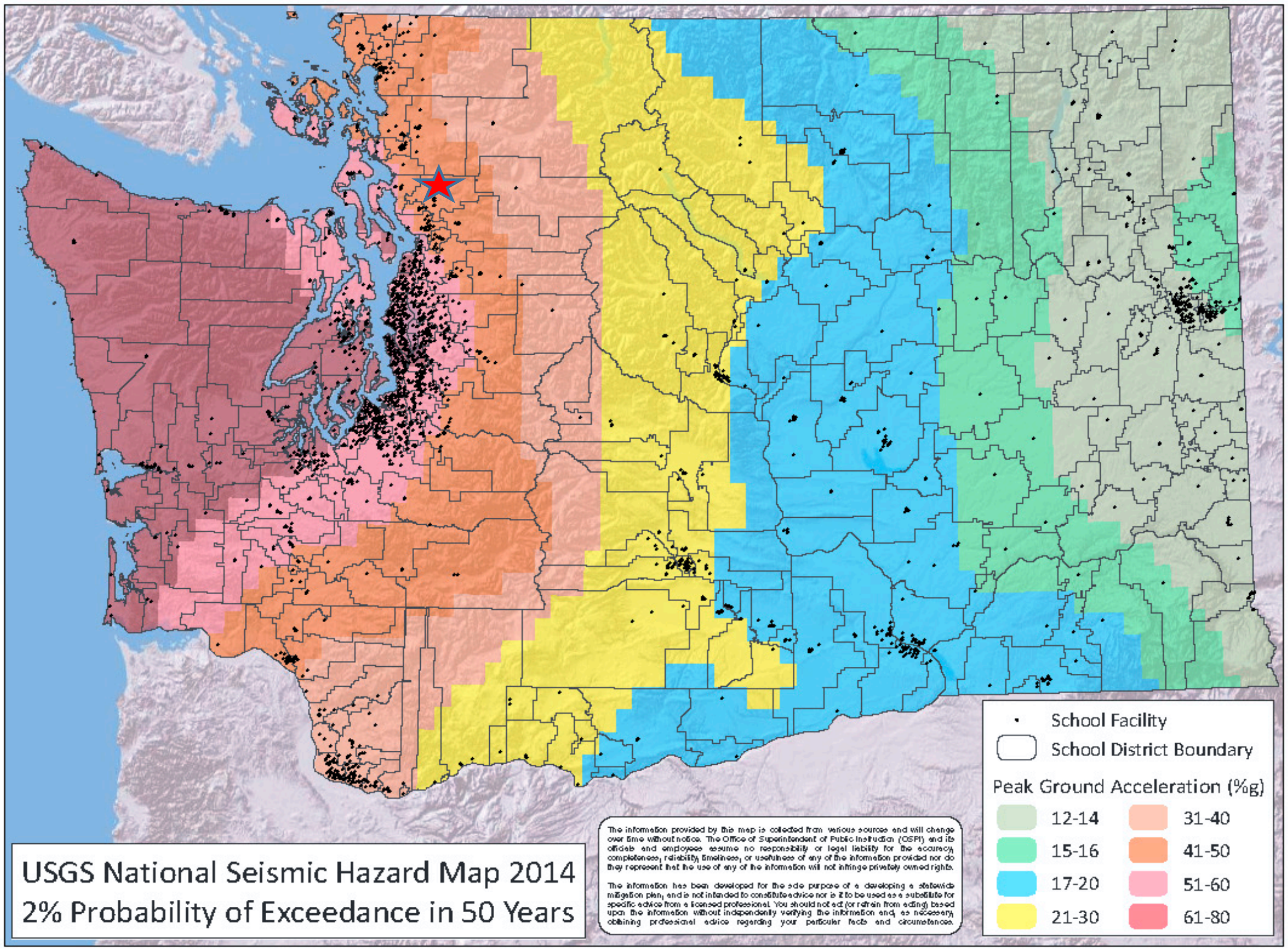


**Figure 6.5**
**2014 USGS Seismic Hazard Map: Washington State[6]**
**PGA value (%g) with a 10% Chance of Exceedance in 50 years**

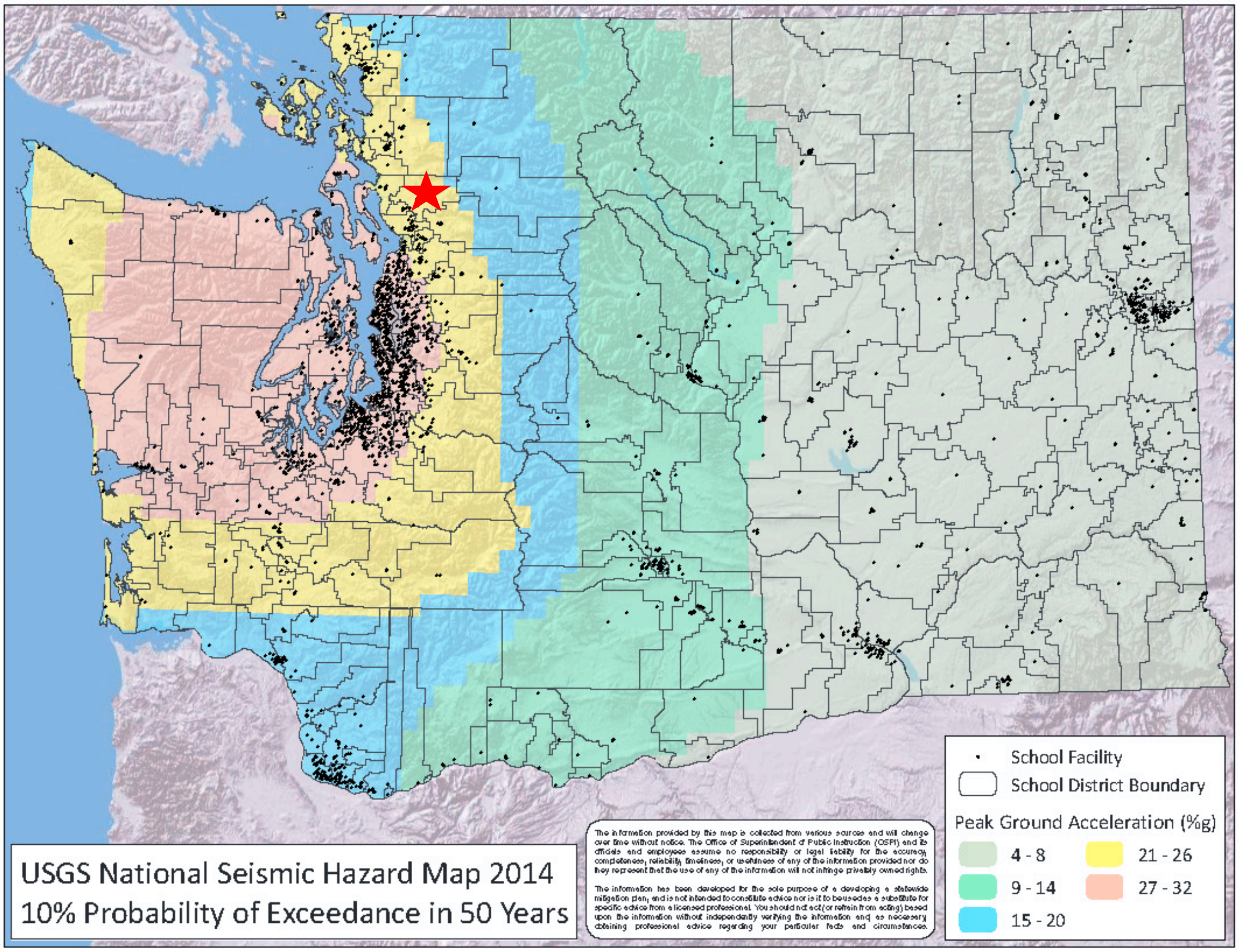


**Figure 6.6**
**2014 USGS Seismic Hazard Map: Puget Sound Area**
**PGA value (percent g) with a 2% Chance of Exceedance in 50 years**

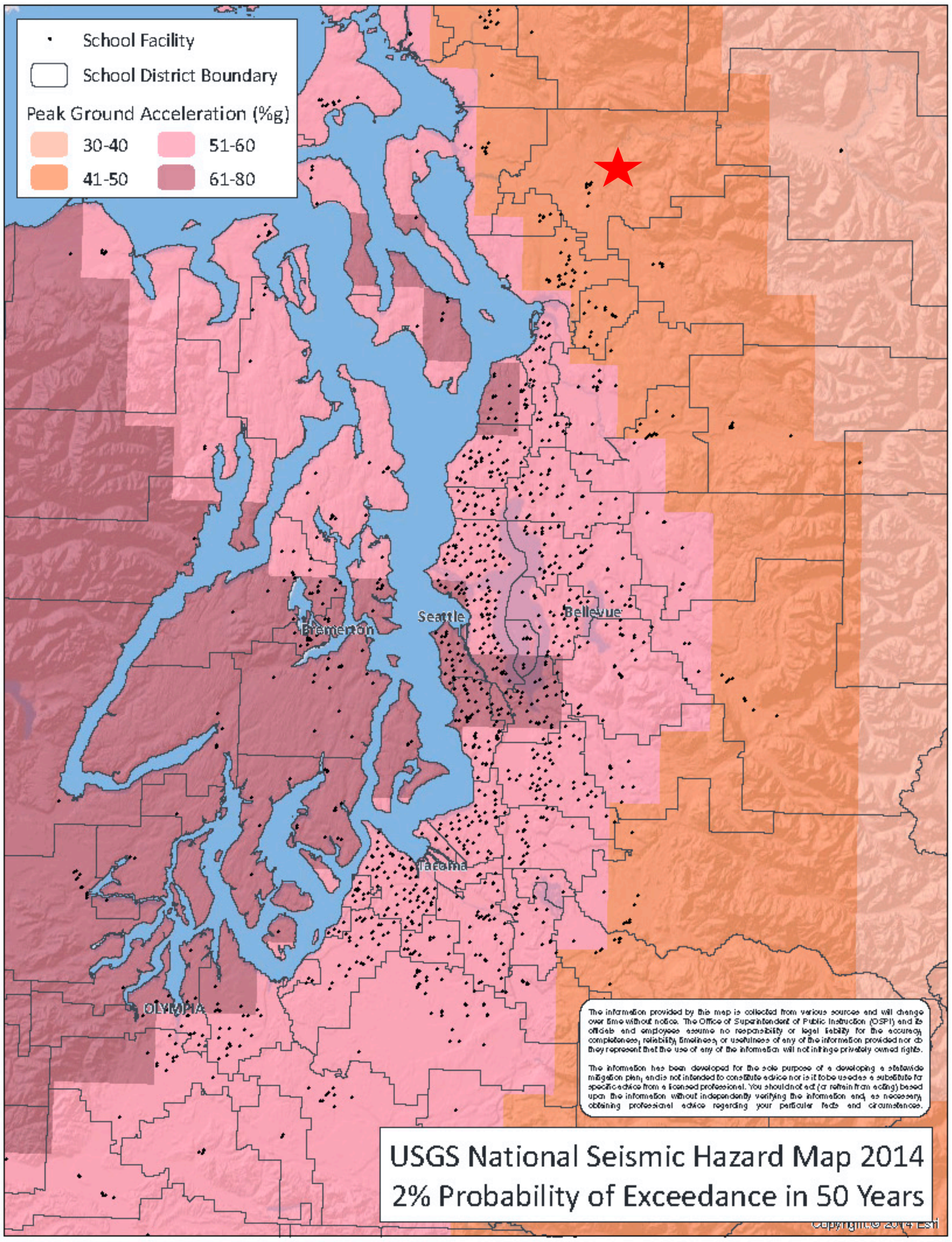
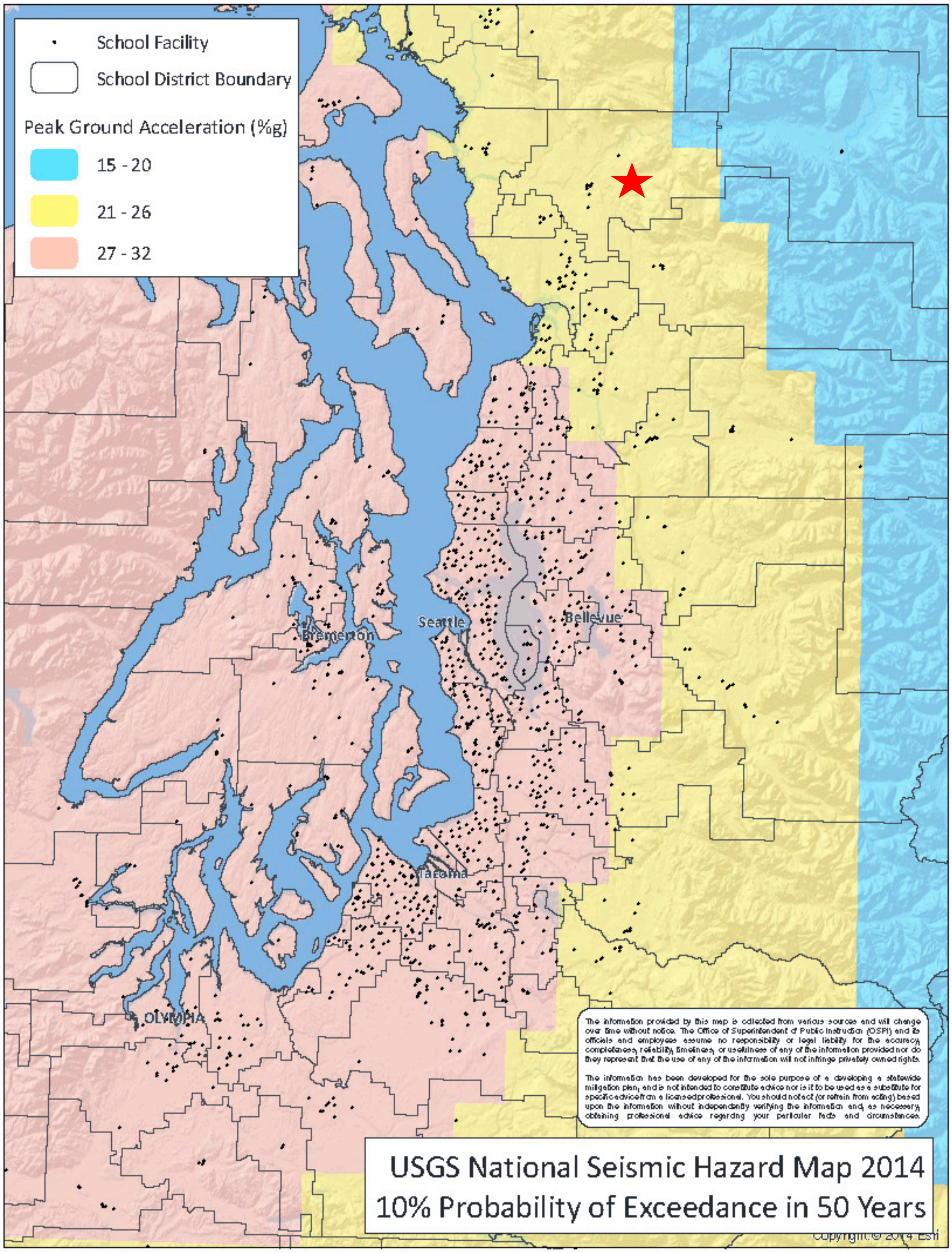


**Figure 6.7**
**2014 USGS Seismic Hazard Map: Puget Sound Area**
**PGA value (percent g) with a 10% Chance of Exceedance in 50 years**



### 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 Arlington Public Schools 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 include 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 Arlington Public Schools are included in the campus-level report in Section 6.7. 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 Arlington Public Schools has campuses with some landslide risk. Further information about this landslide risk is included in the landslide chapter of this mitigation plan.

## 6.7 Seismic Risk Assessment for the Arlington Public Schools' Facilities

The potential impacts of future earthquakes on the Arlington 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 Arlington 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.

Examples of 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 |
| **ARLINGTON PUBLIC SCHOOLS** | | | | | | | | | |
| "A" Building and District Storage | 42.80% | C | High | Low | High | Yes | High | No | N/A |
| Arlington High School | 43.07% | C | High | Unknown | High | Yes | High | No | N/A |
| District Administration | 44.36% | C-D | High | Very Low | High | Yes | High | No | N/A |
| Eagle Creek Elementary School | 44.26% | C-D | High | Very Low | High | Yes | High | No | N/A |
| Haller Middle School | 44.38% | C-D | High | Low | High | Yes | High | No | N/A |
| Kent Prairie Elementary School | 42.45% | D-E | High | Low to Moderate | High | Yes | High | Yes | Moderate |
| Pioneer Elementary School | 43.14% | C | High | Unknown | High | Yes | High | No | N/A |
| Post Middle School | 44.25% | C-D | High | Very Low | High | Yes | High | No | N/A |
| Presidents Elementary School | 42.76% | C | High | Low | High | Yes | High | No | N/A |
| Stillaguamish Valley School | 42.40% | D-E | High | Low to Moderate | High | Yes | High | Yes | Moderate |
| Trafton Elementary School | 43.51% | C-D | High | Very Low | High | Yes | High | No | N/A |
| Transportation | 42.89% | D-E | High | Low to Moderate | High | Yes | High | Yes | Moderate |
| Weston High School | 43.47% | D-E | High | Low to Moderate | High | Yes | High | Yes | Moderate |

[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. The numerical value is the level of ground shaking which has a 2% chance of being exceeded in a 50-year time period.

[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.

The statements in Table 6.2 indicating that building level risk assessments are a high priority for all campuses is based only on the high seismic hazard level of all the District's facilities. The level of earthquake risk varies markedly from building to building depending on the year built and the structural details. Building-level risk assessments are recommended only for a subset of the District's buildings as shown in Table 6.3.

**Table 6.3**
**Building-Level Earthquake Report**

| Building-Level Earthquake Report | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Building - Area | Seismic Design Criteria | | | | Building Type[0] | Seismic Design Basis | 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] | Completed (Yes/No) | ASCE 41-13 Compliant (Yes/No) | Further Eval Desired | | | |
| ARLINGTON PUBLIC SCHOOLS | | | | | | | | | | | | | | |
| "A" Building and District Storage Facility | | | | | | | | | | | | | | |
| Building "A" - Area 1 | 1936 | | | No | C1L | Pre Code | Yes | Moderate to High | No | | | | | |
| Building "A" - Area 2 | 2005 | | | Yes | W1 | High Code | No | Low[4] | N/A[5] | | | | | |
| Building "A" - Greenhouse | 1992 | | | No | S3 | High Code | No | Low[4] | N/A[5] | | | | | |
| Food Service Dry Storage Building - Area 1 | 1968 | | | No | RM1L | Low Code | No | Low[4] | N/A[5] | | | | | |
| Grounds Department Storage Building - Area 1 | 1992 | | | Yes | W2 | Moderate Code | No | Low[4] | N/A[5] | | | | | |
| Arlington High School Facility | | | | | | | | | | | | | | |
| AF JROTC Portable - Area 1 | 1996 | | | No | Portable | Moderate Code | No | Low[4] | N/A[5] | | | | | |
| Greenhouse - Area 1 | 2003 | | | No | S3 | High Code | No | Low[4] | N/A[5] | | | | | |
| Industrial Arts Building - Area 1 | 2003 | | | No | S3 | High Code | No | Low[4] | N/A[5] | | | | | |
| Main Building - Area 1 | 2003 | | | Yes | RM2L | High Code | No | Low[4] | N/A[5] | | | | | |
| Stadium - Area 1 | 2003 | | | Yes | RM1L | High Code | No | Low[4] | N/A[5] | | | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stadium Storage - Area 1 | 2003 | | | Yes | RM1L | High Code | No | Low[4] | N/A[5] | | | | | |
| Stadium Ticket Booth - Area 1 | 2003 | | | Yes | RM1L | High Code | No | Low[4] | N/A[5] | | | | | |
| District Administration Facility | | | | | | | | | | | | | | |
| District Administration Office (Roosevelt) - Area 1 | 1940 | | | No | C1L | Pre Code | Yes | Moderate to High | No | | | | | |
| Eagle Creek Elementary School Facility | | | | | | | | | | | | | | |
| Portable 3 - Area 1 | 1998 | | | No | Portable | High Code | No | Low[4] | N/A[5] | | | | | |
| Portable 4 - Area 1 | 1998 | | | No | Portable | High Code | No | Low[4] | N/A[5] | | | | | |
| Covered Play - Covered Play | 1989 | | | No | C1L | Moderate Code | Yes | Moderate | No | | | | | |
| Main Building - Main Building | 1989 | | | No | RM1L | Moderate Code | Yes | Moderate | No | | | | | |
| Metal Storage Building - Area 1 | 1989 | | | No | S3 | Moderate Code | No | Low[4] | N/A[5] | | | | | |
| Haller Middle School Facility | | | | | | | | | | | | | | |
| Gymnasium Building - Gym | 1978 | | | No | RM1L | Moderate Code | Yes | Moderate to High | No | | | | | |
| Hartz Field Bathroom and Storage Building - Area 1 | 1965 | | | No | RM1L | Low Code | No | Low[4] | N/A[5] | | | | | |
| Hartz Field Concession Building - Area 1 | 1965 | | | No | W1 | Low Code | No | Low[4] | N/A[5] | | | | | |
| Main Building - Main Building | 2006 | | | Yes | S2L | High Code | No | Low[4] | N/A[5] | | | | | |
| Music Building - Music/Art | 1968 | | | No | RM1L | Low Code | Yes | Moderate to High | No | | | | | |
| Kent Prairie Elementary School Facility | | | | | | | | | | | | | | |
| Covered Play - Area 1 | 1993 | | | No | C1L | Moderate Code | Yes | Moderate | No | | | | | |
| Main Building - Area 1 | 1993 | | | No | RM1L | Moderate Code | Yes | Moderate | No | | | | | |
| Pioneer Elementary School Facility | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Main Building - Main | 2002 | | | Yes | S2M | High Code | No | Low[4] | N/A[5] | | | | | |
| Post Middle School Facility | | | | | | | | | | | | | | |
| B Building - Gym - Gym | 1981 | | | No | RM1L | Moderate Code | Yes | Moderate to High | No | | | | | |
| Building A Main - Main | 1981 | | | Yes | W2 | Moderate Code | Yes | Low[4] | No | | | | | |
| C Building - Art/Home Living/Woods - Art/Woods/Home | 1981 | | | No | RM1L | Moderate Code | Yes | Moderate | No | | | | | |
| D Building Classrooms - Classrooms | 1993 | | | No | RM1L | Moderate Code | Yes | Moderate | No | | | | | |
| Metal Storage (Senica) - Area 1 | 1981 | | | No | S3 | Moderate Code | No | Low[4] | N/A[5] | | | | | |
| Portable 2 - Area 1 | 1999 | | | No | Portable | High Code | No | Low[4] | N/A[5] | | | | | |
| Portable 3 - Area 1 | 1999 | | | No | Portable | High Code | No | Low[4] | N/A[5] | | | | | |
| Portable 4 - Area 1 | 1999 | | | No | Portable | High Code | No | Low[4] | N/A[5] | | | | | |
| Portable 5 - Area 1 | 1999 | | | No | Portable | High Code | No | Low[4] | N/A[5] | | | | | |
| Presidents Elementary School Facility | | | | | | | | | | | | | | |
| Main Building - Area 1 | 2004 | | | Yes | S2L | High Code | No | Low[4] | N/A[5] | | | | | |
| Stillaguamish Valley School Facility | | | | | | | | | | | | | | |
| Portable 1 Office - Area 1 | 1999 | | | No | Portable | High Code | No | Low[4] | N/A[5] | | | | | |
| Portable 2 - Area 1 | 1997 | | | No | Portable | Moderate Code | No | Low[4] | N/A[5] | | | | | |
| Portable 3 - Area 1 | 1997 | | | No | Portable | Moderate Code | No | Low[4] | N/A[5] | | | | | |
| Portable 4 - Area 1 | 2002 | | | No | Portable | High Code | No | Low[4] | N/A[5] | | | | | |
| Portable 5 - Area 1 | 2001 | | | No | Portable | High Code | No | Low[4] | N/A[5] | | | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Portable 6 - Area 1 | 1995 | | | No | Portable | Moderate Code | No | Low[4] | N/A[5] | | | | | |
| Portable 7 - Area 1 | 1997 | | | No | Portable | Moderate Code | No | Low[4] | N/A[5] | | | | | |
| Portable 8 - Area 1 | 1995 | | | No | Portable | Moderate Code | No | Low[4] | N/A[5] | | | | | |
| Portable 9 - Area 1 | 1995 | | | No | Portable | Moderate Code | No | Low[4] | N/A[5] | | | | | |
| Portable 10 - Area 1 | 1991 | | | No | Portable | Moderate Code | No | Low[4] | N/A[5] | | | | | |
| Portable 11 - Restrooms | 2001 | | | No | Portable | High Code | No | Low[4] | N/A[5] | | | | | |
| Trafton Elementary School Facility | | | | | | | | | | | | | | |
| Covered Play - Area 1 | 1965 | | | No | W1 | Low Code | Yes | Low[4] | N/A[5] | | | | | |
| Main Building - Area 1 | 1906 | | | No | W2 | Pre Code | Yes | Low[4] | N/A[5] | | | | | |
| Transportation Facility | | | | | | | | | | | | | | |
| Pupil Transportation - Area 1 | 1973 | | | No | W2 | Low Code | Yes | Moderate | No | | | | | |
| Weston High School Facility | | | | | | | | | | | | | | |
| Main Building - Area 1 | 1978 | | | No | S4L | Moderate Code | Yes | Moderate | No | | | | | |

These codes describe the classifications of the structural type for a building which provide the building's strength to resist both vertical and horizontal forces. See Appendix D for descriptions.

[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.

[4] "Low" indicates that the either the ASCE 41-13 Tier 1 Evaluation wasn't recommended for this building, the building isn't listed as a priority as it was built under the "high" code or has minimal occupancy. These risk levels and priorities for further evaluation have been modified to reflect district-specific information and priorities that differ from the information in ICOS. Therefore, these rankings differ from the auto-generated rankings in ICOS.

[5] "N/A" indicates that the building doesn't require an ASCE 41-13 Tier 1 Evaluation or was not noted to be a high priority.

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.

Every school in the Arlington Public Schools has a high level of earthquake hazard. A number of schools that have softer soils (Site Class D-E) also have a low to moderate liquefaction risk, which includes Kent Prairie Elementary School, Stillaguamish Valley School and Weston High School, as well as the Transportation building. A low liquefaction risk exists for the A building, Haller Middle School and President Elementary School.

At building level, most schools have at least one building with a moderate to high earthquake risk. This includes Building A (building area 1 and food service storage), the District Administrative Office, Eagle Creek Elementary School (main building), Haller Middle School (gymnasium and music building) and Post Middle School (gymnasium). Pioneer Elementary School (Main Building), Presidents Elementary School and Stillaguamish Valley School have a low earthquake risk. According to this data, the highest risk building is the main building at Weston High School. However, as noted in Chapter 3, Weston effectively meets the most recent code and is not as high of a risk.

## 6.8 Previous Earthquake Events

The district has not experienced any damage in previous earthquakes.

## 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 Arlington Public Schools are given in Table 6.4.

**Table 6.4**
**Arlington Public Schools: 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 | Evaluate the Seismic vulnerability of the buildings identified by the preliminary screening as likely being at moderate to high risk by having an engineer complete ASCE 41-13 Tier 1 screenings for all or a prioritized subset of these buildings. Order of priority would be Post, Eagle Creek, Kent Prairie, Weston, Haller, District Office, Transportation and A building | 1-2 Years | District or Grant | Supt. | X | X | | X |
| Short Term #2 | 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 Grant | Supt. | X | X | | X |
| Short Term #3 | Evaluate the foundations of the portable buildings to determine whether they are adequate for earthquakes. | 1-3 Years | District or Grant | Supt. | X | X | | X |
| Long Term #1 | Prioritize and implement seismic retrofits or replacements based on the results of the above detailed evaluations, as funding becomes available. | Ongoing | District or Grant | 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 Grant | Supt. | X | X | | X |
| Long Term #3 | Enhance emergency planning for earthquakes including duck and cover and evacuation drills | Ongoing | District or Grant | 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.

http://www.crew.org/sites/default/files/cascadia_subduction_scenario_2013.pdf

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.

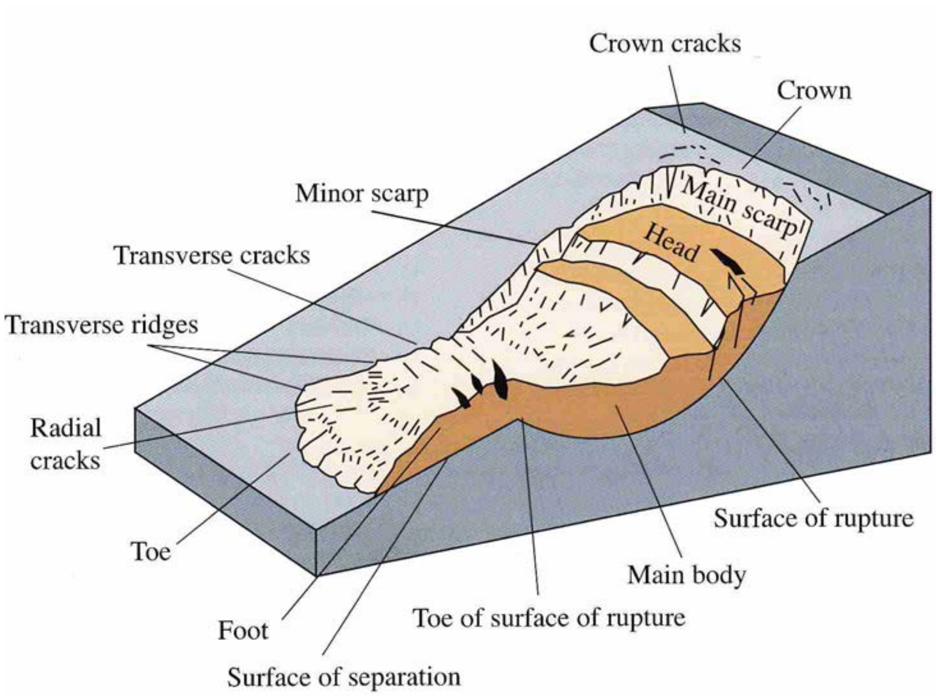
# 7.0 LANDSLIDES:

## 7.1 Landslide Overview and Definitions

The term “landslide” refers to a variety of slope instabilities that result in the downward and outward movement of slope-forming materials, including rocks, soils and vegetation. Many types of landslides are differentiated based on the types of materials involved and the mode of movement.

The descriptive nomenclature for landslides is summarized in the following figure.

**Figure 7.1**
**Landslide Nomenclature[1]**




Debris flows and mudslides (mudflows) are often differentiated from the other types of landslides, for which the sliding material is predominantly soil and/or rock. Debris flows and mudslides typically have high water content and may behave similarly to floods. However, debris flows may be much more destructive than floods because of their higher densities, high debris loads, and high velocities.

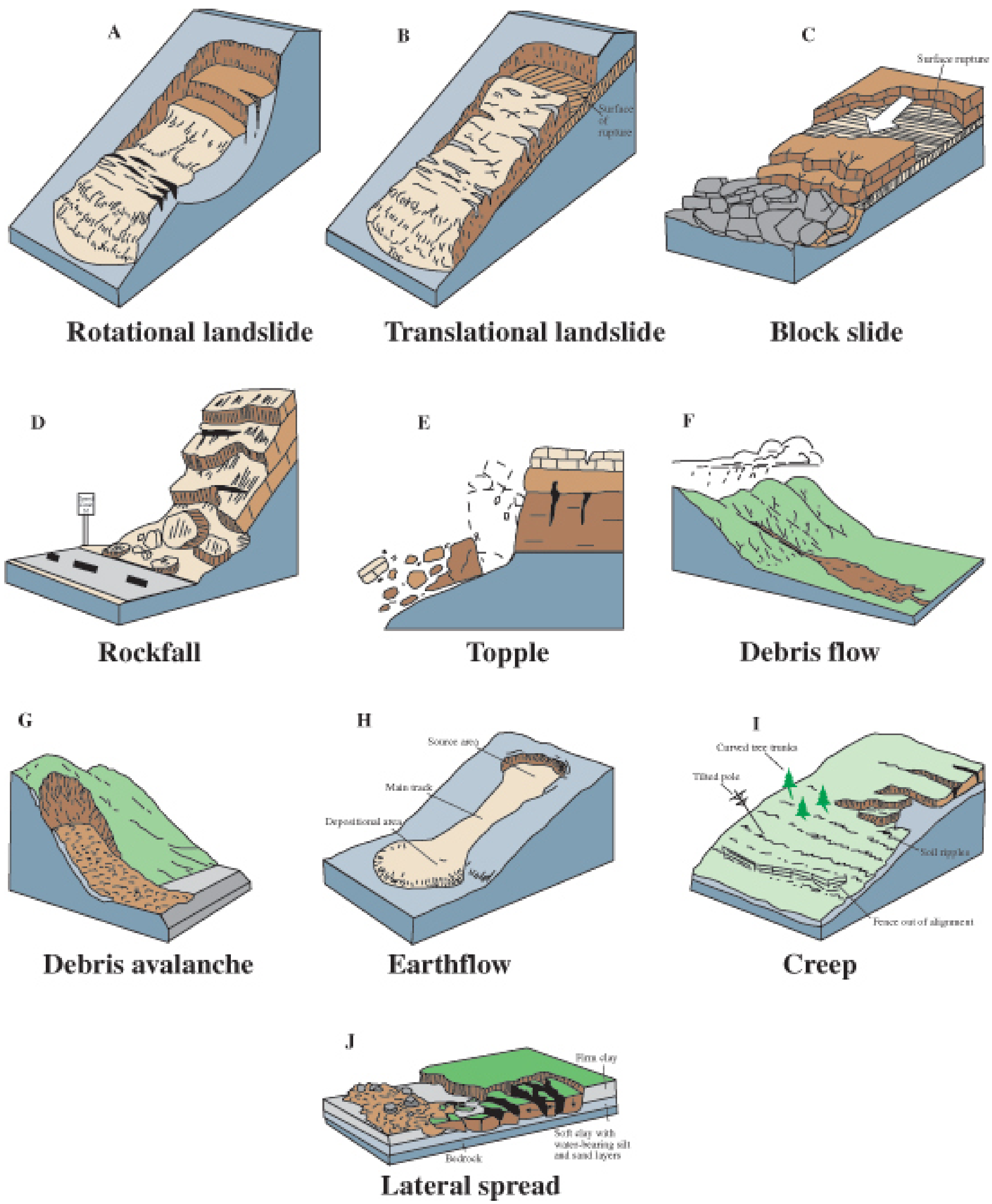
There are three main factors that determine the susceptibility (potential) for landslides at a given location:

1) Slope,

2) Soil/rock characteristics, and

3) Water content.

**Figure 7.2**
**Major Types of Landslides[1]**



Steeper slopes are more prone to all types of landslides.  Loose, weak rock or soil is more prone to landslides than are competent rocks or dense, firm soils.  Water saturated soils or rocks with a high water table are much more prone to landslides because the water pore pressure decreases the shear strength of the soil or rock and thus increases the probability of sliding.

Most landslides occur during rainy months when soils are saturated with water.  As noted previously, the water content of soils or rock is a major factor in determining the likelihood of sliding for any given landslide-prone location.  However, landslides may occur at any time of year, in dry months as well as in rainy ones.

Landslides are also commonly initiated by earthquakes.  Areas prone to seismically triggered landslides are exactly the same as those prone to ordinary (non-seismic) landslides.  As with ordinary landslides, seismically triggered landslides are more likely from earthquakes that occur when soils are saturated with water.

Any type of landslide may result in damages or complete destruction of buildings in their path, as well as deaths and injuries for building occupants.  Landslides frequently cause road blockages by depositing debris on road surfaces or road damage if the road surface itself slides downhill.  Utility lines and pipes are also prone to breakage in slide areas.

The destructive power of major landslides was demonstrated by the devastating March 2014 landslide in Oso, Washington which resulted in in several dozen deaths as well as extreme damage to buildings and infrastructure.  This landslide is illustrated on the following page.

The following figures show examples of landslides in Washington State.

**Figure 7.3**
**Oso Landslide 2014[3]**
**Before and After the Landslide**
**Landslide Type: Debris Flow (Mudslide)**

**Figure 7.4**
**Road 170 near Basin City 2006[4]**
**Landslide Type: Debris Flow**

**Figure 7.5**
**Highway 410 near Town of Nile 2009[5]**
**Landslide Type: Translational**

**Figure 7.6**
**Rolling Bay, Bainbridge Island 1997[2]**
**Landslide Type: Debris Flow**

### 7.2 Landslide Hazard Mapping and Hazard Assessment

There are two approaches to landslide hazard mapping and hazard assessment:

- Mapping historical landslides, which also provides an indication of the potential for future landslides, and
- Landslide studies by geotechnical engineers to estimate the potential for future landslides.

Maps of areas within Washington with moderate or high landslide incidence and landslide potential are shown in Figures 7.7 and 7.8.

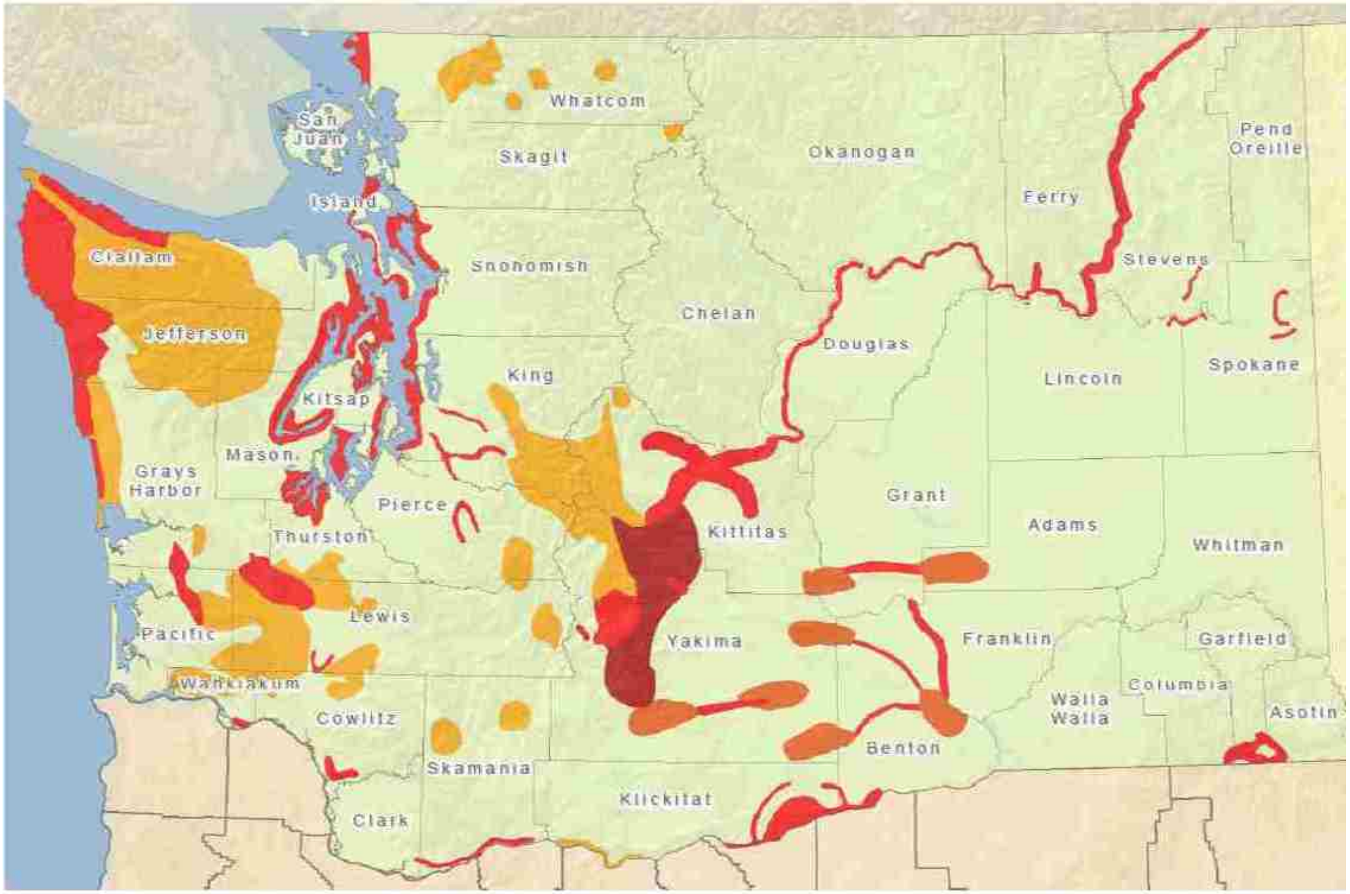
A more accurate understanding of the landslide hazard for a given campus requires a more detailed landslide hazard evaluation by a geotechnical engineer. Such site-specific studies evaluate the slope, soil/rock and groundwater characteristics at specific sites. Such assessments of often require drilling to determine subsurface soil/rock characteristics

An important caveat for landslide hazard assessments is that, even with detailed site-specific evaluations by a geotechnical engineer, there is inevitably considerable uncertainty. That is, it is very difficult to make quantitative predictions of the likelihood or the size of future landslide events. In some cases, landslide hazard assessments by more than one geotechnical engineer may reach conflicting opinions.

These limitations and uncertainties notwithstanding, a detailed site-specific landslide hazard assessment does provide the best available information about the likelihood of future landslides. For example, such studies can provide enough information to determine that the landslide risk is higher at one location than another location and thus provide meaningful guidance for siting future development.

Given the above considerations, landslide hazard and risk assessments are generally qualitative or semi-quantitative in nature.

**Figure 7.7**
**Landslide Incidence and Potential[2]**



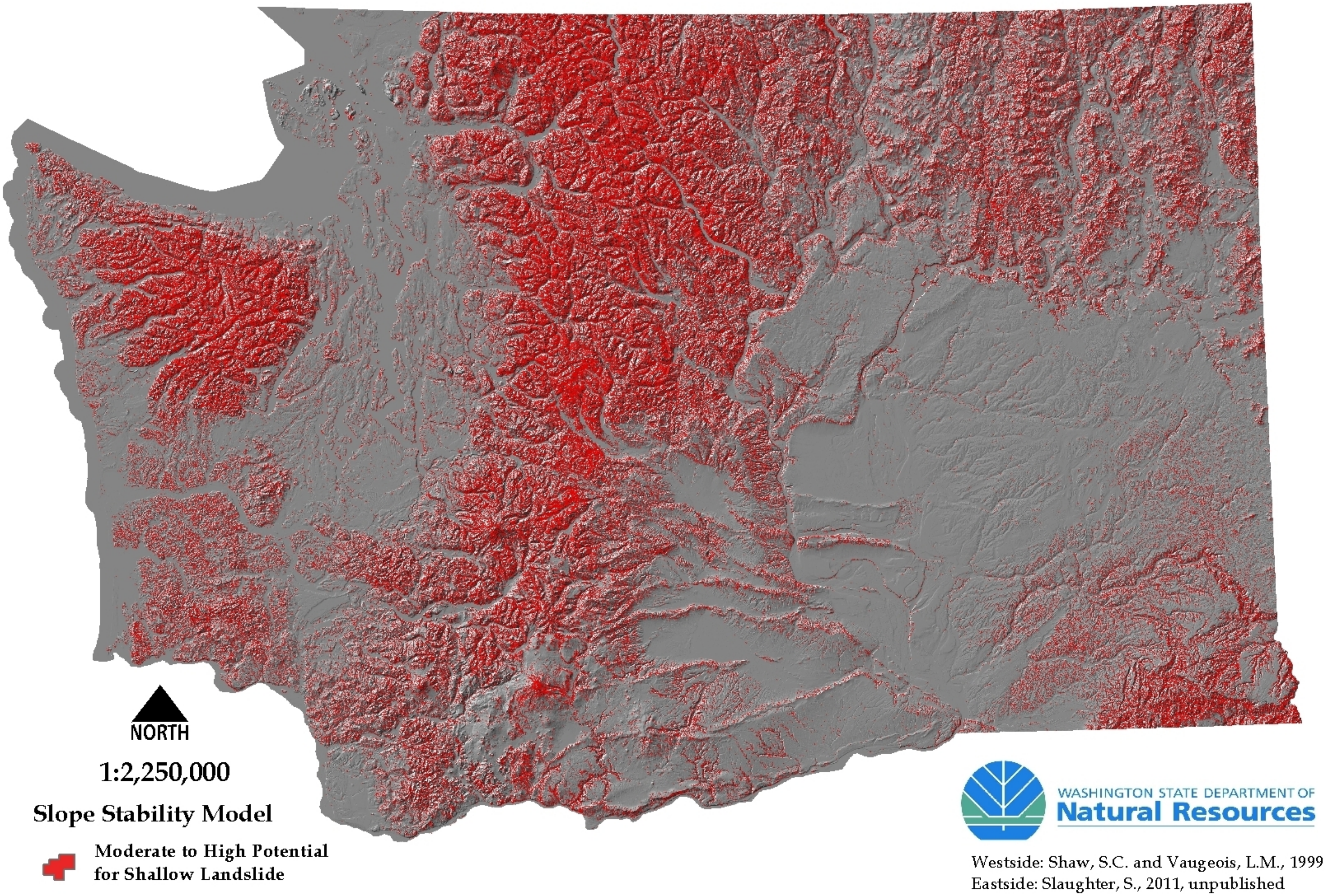

High Incidence: >15% of area involved

Moderate Incidence: 1.5% to 15% of area involved

Low Incidence: <1.5% of area involved

High Susceptibility
Moderate Susceptibility

**Figure 7.8**
**Department of Natural Resources – Landslide Potential Map[5]**



### 7.3 Arlington Public Schools: Landslide Hazard and Risk Assessment

The potential impacts of future landslides on the Arlington District include deaths and injuries, 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 vulnerability of the Arlington District's facilities to landslides varies from campus to campus. The approximate levels of landslide hazards and vulnerability are identified at the campus level in the following sections.

There have been no historical landslides that directly affected any of the district's campuses. However the Oso Landslide (described above) occurred within the border of the district.

Campus-level landslide hazard and risk assessments are made in the OSPI ICOS Pre-Disaster Mitigation database, using the following data:

- Slope data in the vicinity of each campus, from digital elevation data for the campus and a grid of data points in the north, south, east, and west directions from the campus.
- Whether or not the campus is within 500 feet of a DNR mapped landslide.
- Information provided by the Arlington Public Schools.
    - Are there channels, gullies or swales upslope from the campus?
    - Are there slumps or historical landslides upslope from the campus?
    - Are there buildings <50 feet from a deeply incised stream or other steep slopes?

The preliminary landslide hazard level is based on slope data only:

| Slope | Preliminary Landslide Hazard Level |
|---|---|
| >40% | High |
| 30% to 40% | Moderate |
| 20% to 30% | Low |
| <20% | Very Low |

The hazard and risk level is increased by one step (but not higher than "high") if there are yes answers to any of the four data points listed above.

As stated previously, more accurate landslide hazard and risk assessment requires a site-specific investigation by a geologist, engineer or geotechnical engineer. Consultation with one of these experts is recommended for all campuses where the preliminary determination of the level of landslide hazard and risk is “moderate” or higher.

**Table 7.1**
**Arlington Public Schools: Campus-Level Landslide Hazard and Risk Assessment**

Landslide Campus-Level Hazard and Risk Report

| Campus | Maximum Slope Near Campus | Preliminary Landslide Hazard Level[0] | Within 500 feet of DNR Mapped Landslides[1] | Channels, Gullies or Swales Upslope | Slumps or Historical Landslides Upslope | Buildings <50 Feet From Incised Stream or Steep Slopes | Preliminary Landslide Risk Level[2] | Consult with Geologist or Geotechnical Engineer[3] |
|---|---|---|---|---|---|---|---|---|
| **Arlington** | | | | | | | | |
| Eagle Creek Elementary School | 29.80% | Moderate | No | No | No | No | Moderate | Yes |
| Kent Prairie Elementary School | 32.85% | Moderate | No | No | No | No | Moderate | Yes |
| Post Middle School | 31.15% | Moderate | No | No | Yes | No | Moderate to High | Yes |

[0] The preliminary hazard level reflects only the maximum slope near the campus, as calculated from GIS elevation data.

[1] Indicates that landslides occur near the campus; landslide hazard for the campus may or may not be significant.

[2] Preliminary landslide risk level based on the combination of the GIS data and campus-specific data (if such is entered). More accurate determination of landslide risk for a campus or for specific buildings requires consultation with a geologist or geotechnical engineer.

[3] Consultation means discuss with a geologist of geotechnical engineer knowledgeable about landslides to determine whether a more detailed study is warranted.

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The preliminary landslide risk levels shown above are based only on statewide GIS data. Review of the site conditions at the three schools listed above has refined the landslide risk assessment.

- Eagle Creek Elementary School’s exposure to a landslide hazard appears to be negligible. There is a steep slope with a drop of about 20 feet at the eastern edge of the campus but this slope is approximately 100 yards from the buildings and thus appears to pose no landslide risk to the buildings.
- Kent Prairie Elementary School’s exposure to a landslide hazard appears to be low, but perhaps not negligible. There is a steep hill south of the buildings with an elevation difference between the hill and the campus of about 100 feet.
- Post Middle School’s exposure to a landslide hazard appears to be significant. There is a very steep, nearly vertical drop of about 130 feet, located about 50 feet from the buildings on the east side of the campus.
- Even though Arlington High School is also adjacent to a ravine, it does not fall within the GIS conditions of concern for landslide

Without more detailed site-specific evaluation of landslide hazards and risk for each campus, it is not possible to make quantitative estimates of the level of risk for each campus.

Qualitatively, for a given campus or a given building, landslide damages can range from very minor damage to complete destruction. Similarly, the numbers of deaths and injuries can range from none, to many dozens (or more) for large slides that occur without warning while a campus or building is highly populated.

## 7.4 Mitigation of Landslide Risk

Mitigation of landslide risks is often difficult from both the engineering and cost perspectives. In many case, there may be no practical landslide mitigation measure. In some cases, mitigation may be possible. Typical landslide mitigation measures include the following:

- Slope stability can be improved by the addition of drainage to reduce pore water pressure and/or by slope stabilization measures, including retaining walls, rock tie-backs with steel rods and other geotechnical methods.
- For smaller landslides or debris flows, protection for existing facilities at risk may be increased by building diversion structures to deflect landslides or debris flows around an at risk facility.
- For very high risk facilities, with a high degree of life safety risk, abandoning the facility and replacing it with a new facility may be the only possible landslide mitigation measure.
- For new construction, siting facilities outside of landslide hazard areas is the most effective mitigation measure.

The Arlington Public Schools Mitigation Action Items for landslides are shown in the table on the following page.

**Table 7.2**
**Arlington Public Schools: Landslide 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 |
| **Landslide Mitigation Action Items** | | | | | | | | |
| Short-Term #1 | Consult with a geologist or geotechnical engineer regarding possible landslide risk from the steep slopes on the east side of the Post Middle School and south side of the Kent Prairie Elementary School. | 1-2 Years | District or Grants | Supt. | X | X | X | X |
| Long-Term #1 | Evaluate possible mitigation measures if the study (short term #1) deems the risk significant at either campus. | 1-2 Years | District or Grants | Supt. | X | X | X | X |

**7.5 References**.

1. United States Geological Survey (2004), Landslide Types and Processes, Fact Sheet 2004-3072.

2. Washington State Military Department, Emergency Management Division (2009), Hazard Identification and Vulnerability Assessment (HIVA).

3. Google Earth photos (2013 and 2014).

4. Washington State Enhanced Hazard Mitigation Plan, Section 5.6, Hazard Profile – Landslide, October 2010.

5. Photo by Washington Department of Natural Resources:

http://www.historylink.org/index.cfm?DisplayPage=output.cfm&file_id=9224

6. Washington Department of Natural Resources (2011), unpublished map: Slope Stability Model for Shallow Landslide Potential, West and East Side.

7. The Watershed Company. July 2010. DRAFT Shoreline Analysis Report for the City of Arlington's Shoreline: South Fork and Main stem Stillaguamish River and Portage Creek. Prepared for the City of Arlington, Arlington, WA

# APPENDIX A

# FEMA MITIGATION GRANT PROGRAMS

# FEMA FUNDING POSSIBILITIES
# FOR SCHOOL DISTRICTS IN WASHINGTON

## A-1.0 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 Arlington Public Schools, the sources of possible FEMA grant funds include the Public Assistance Program, the Hazard Mitigation Grant Program, and the Pre-Disaster Mitigation Program.

## A-2.0 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

## A-3.0 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.

## A-4.0 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.

## A-5.0 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.

### A-5.1 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%.

### A-5.2 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.

## A-6.0 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 B

# PRINCIPLES

# OF

# BENEFIT-COST ANALYSIS

## B-1.0 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.

## B-2.0 What are the 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.

### B-3.0 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.

**B-4.0 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.

## B-5.0 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 B2.1.

**Table B2.1**
**Damages Before Mitigation**

| Flood Depth (feet) | Annual Probability of Flooding | Scenario Damages and Losses Per Flood | 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 B2.1 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 B2.1 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 B2.2 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 B2.2.

**Table B2.2**
**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 B2.3**
**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.

# APPENDIX C

# Public Notices
# and
# Meetings

# Public Notices

### *Arlington Public Schools Website: http://asd.wednet.edu/*

DISTRICT NEWS

**You're invited to comment on the APS Hazard Mitigation Plan**
Arlington Public Schools is hosting a public meeting on Tuesday, Feb. 7 at 6 p.m. at the district office to receive comments on the district's draft Hazard Mitigation Plan. You can also comment on the plan by going to this **page**.

## *Email message to local stakeholders*

**Arlington Public Schools has been working with the Federal Emergency Management Agency (FEMA) and the Office of Superintendent of Public Instruction to develop a draft Hazard Mitigation Plan to cover each of the major natural hazards that pose significant threats to the school district.**

**FEMA would like the plan to foster local, state and federal partnerships for hazard mitigation. We invite you to review the plan which is attached to this email.**

**A webpage has been developed where you can submit any comments you might have about the plan. You can submit your comments here or by going to the Arlington Public Schools website (www.asd.wednet.edu) and going to the Facilities section. A copy of the plan is also available on this webpage.**

**You are also welcome to attend a public meeting on Tuesday, Feb. 7 at 6 p.m. at the APS district office, 315 N. French Ave. in Arlington, to make comments on the plan.**

**Please call or email me if you have any questions.**

**Thank you.**

## *Press Release*

News Release

FOR IMMEDIATE RELEASE

Jan. 10, 2017

Gary Sabol

360-618- 6217

Arlington Public Schools seeking comments on draft Hazard Mitigation

Plan

ARLINGTON- Arlington Public Schools (APS) is hosting a public meeting on Tuesday, Feb. 7 at 6 p.m. at the APS district office, 315 N. French Ave. in Arlington, to receive comments on the district's draft Hazard Mitigation Plan.

The draft plan covers each of the major natural hazards that pose significant threats to the school district. The purpose of the plan is to proactively facilitate and support districtwide policies, practices and programs that make APS more disaster resistant and disaster resilient.

If you are unable to attend this meeting, comments can also be submitted online at this link. Please submit online comments by Monday, Feb. 6. A copy of the plan can be found here or by going to the Administration-Facilities section on the district website (www.asd.wednet.edu).

Please contact Brian Lewis at 360-618- 6238 or blewis@asd.wednet.edu with questions about the public meeting.

### *Article in the Everett Herald*

# Arlington School District drafts disaster readiness plan

- Kari Bray
- Wed Jan 18th, 2017 1:30am

ARLINGTON — The school district here is putting together a plan to prepare for natural disasters.

The plan is meant to address hazards that might threaten schools and other district buildings. It lays out suggestions for how to update buildings and add rules or routines to keep people and property safe.

Planners say damage from disasters can be minimized by teaching people about preparation, making sure buildings are up to safety standards and having a plan for how to react in case of an emergency.

The Arlington School District started putting together a plan for natural hazards in 2014, said Brian Lewis, executive director of operations. Though that was the same year as the Oso mudslide, the plan is not directly related to that deadly disaster, he said. It's a document that had been requested by state and federal agencies.

“The hazard mitigation plan focuses on all forms of major natural hazards,” Lewis said. “It’s not just landslides that are associated with this plan, and it is a FEMA-approved document, so it goes beyond things we might experience here.”

A draft of the district’s plan now is available online. Officials are looking for suggestions from the public. The goal is to bring the plan to the school board for revisions and approval by the end of February. From there, it goes through state and then federal agencies, ending with a review by FEMA.

Comments are being accepted online and a public meeting is planned for Feb. 7. To view the plan or leave a comment, go to asd.wednet.edu/administration/facilities.

“Take the time to ask questions if you have any,” Lewis said. “We’re doing our due diligence to protect the safety of our students and the community.”

The document looks at where the level of risk from natural hazards might be “unacceptably high” and how it could be reduced. Local governments and districts must adopt plans in order to be eligible for some FEMA grants.

All of Arlington’s schools are close enough to active faults — as is the case throughout Western Washington — to have a high likelihood of experiencing an earthquake at some point, though the level of risk depends largely on the condition of buildings, planners say.

Post Middle School also is considered to be at moderate to high risk from a landslide and Kent Prairie Elementary School is at low landslide risk.

None of the district’s buildings are thought to be threatened by a tsunami, volcanic eruption, flood or wildfire. The structures are not within volcanic hazard zones, are above known floodplains, are miles from the coast and have easy access to water and limited vegetation nearby to fuel fires.

The document recommends retrofitting or replacing buildings that are not up to earthquake standards and having a plan for how to react in an earthquake and evacuate afterward. Those already are being drilled with students and staff, Lewis said.

To move forward with seismic updates for buildings in the district, a study is needed that goes beyond the routine survey of conditions, Lewis said. Adopting a hazard plan would let the district qualify for grants to pay for such a study.

The draft plan also suggests working closely with the city, local businesses and emergency responders to make sure response and recovery is coordinated across agencies. Teaching people about natural hazards and setting up a section of the high school and local libraries with resources, including a copy of the plan, is another recommendation.

http://www.heraldnet.com/news/arlington-school-district-drafts-disaster-readiness-plan/?twitter

## *Article from the Everett Herald picked up by the “eClippings” platform for the Washington State School Directors Association (WSSDA)*

### Everett Herald

- Arlington School District drafts disaster readiness plan
- Monroe School Board picks interim member with district ties

# Public Meetings

## *School Board Meeting*

### *Agenda*

**BOARD OF DIRECTORS' REGULAR MEETING** Monday, January 9, 2017 – 6:00 pm Administration Bldg Board Room

315 N French Ave; Arlington, WA 98223

| | | |
|---|---|---|
| **1.** | **Call to Order**<br>A. Pledge of Allegiance<br>B. Approval of the Agenda<br>C. Approval of Special Meeting Minutes – December 9, 2016<br>D. Approval of Regular Meeting Minutes – December 12, 2016<br>E. Approval of Special Meeting Minutes – December 16, 2016 | <br><br>ACTION<br>ACTION<br>ACTION<br>ACTION |
| **2.** | **Student Presentations**<br>A. Arlington High School Jazz Combo, Dessert, & Invitation to Board Recognition Dinner<br>B. Weston High School – Project/Problem Based Learning | |
| **3.** | **Comments from Audience Members** | |
| **4.** | **Consent Agenda**<br>A. Budget Report<br>B. Personnel Report<br>C. Payroll Report – December 2016<br>D. Vouchers and Warrant<br>E. Adjusted Warrants | ACTION |
| **5.** | **New Business**<br>A. Bond Refunding<br>B. Resolution 17-01 State Guarantee – Refinancing of 2007 Bonds<br>C. Resolution 17-02 Delegation – Refinancing of 2007 Bonds<br>**~ Brief Recess ~**<br>D. Hazard Mitigation Plan<br>E. Policy for Second Reading and Adoption<br>• Policy 4210 – Community Relations – Regulation of Dangerous Weapons - revise<br>F. Policy for First Reading and Discussion of Related Procedure<br>• Policy 5010 – Personnel – Non-Discrimination and Affirmative Action – revise<br>• Proced 5010P – Personnel – Non-Discrimination and Affirmative Action - revise<br>G. 2016-2021 Affirmative Action Plan - Arlington School Dist. No. 16 | <br>BRIEFING<br>ACTION<br>ACTION<br><br>BRIEFING<br>ACTION<br><br>DISCUSSION<br><br><br>ACTION |

| | | |
|---|---|---|
| 6. | **Informational Items**<br>A. Superintendent's Report<br>B. Comments from Board Members<br>C. Next Meetings<br>• Special Meeting/Workshop – Thursday, January 19, 2017, 7:00 pm<br>Dunlap Conf. Rm, Channel Lodge, 205 N First St, La Conner, WA 98257<br>• Special Meeting/Workshop – Friday, January 20, 2017, 8:30 am<br>Dunlap Conf. Rm, Channel Lodge, 205 N First St, La Conner, WA 98257<br>• Regular Business Meeting – Monday, January 23, 2017, 6:00 pm<br>Admin. Building Board Room, 315 N French Ave, Arlington, WA | |
| 7. | **Executive Session** – *for consideration of a minimum price at which real estate will be offered for sale* | |
| 8. | **Adjourn** | ACTION |

Individuals with disabilities who may need a modification to participate in a meeting should contact the Superintendent's Office at 360.618.6202 no later than two days before a regular meeting and as soon as possible in advance of a special meeting so that special arrangements can be made.

*Minutes*

ARLINGTON
Public Schools

**Board of Directors**
# Meeting Minutes
Monday, January 9, 2017

President Jeff Huleatt called the regularly scheduled business meeting of the Arlington Public Schools Board of Directors to order at 6:00 pm in the Administration Building Board Room, 315 N. French Ave, Arlington, WA. Also present were Directors Jim Weiss, Kay Duskin, Ursula Ghirardo, and Bob McClure, and Student Advisor Edward Radion. Student Advisor Mary Catherine Meno was absent and excused.

The Pledge of Allegiance was conducted.

**APPROVAL OF THE AGENDA**
Director Ghirardo moved to approve the agenda as presented. Director Duskin seconded the motion, which passed unanimously by voice vote.

**APPROVAL OF THE MINUTES OF THE DECEMBER 9, 2016 SPECIAL MEETING**
President Huleatt asked if there were any corrections to the special meeting minutes of December 9. There being none, Director Duskin moved to approve the minutes as presented. Director Weiss seconded the motion, which passed unanimously by voice vote.

**APPROVAL OF THE MINUTES OF THE DECEMBER 12, 2016 REGULAR MEETING**
President Huleatt asked if there were any corrections to the regular meeting minutes of December 12. There being none, Director Weiss moved to approve the minutes as presented. Director McClure seconded the motion, which passed unanimously by voice vote.

**APPROVAL OF THE MINUTES OF THE DECEMBER 16, 2016 SPECIAL MEETING**
President Huleatt asked if there were any corrections to the special meeting minutes of December 16. There being none, Director Ghirardo moved to approve the minutes as presented. Director Duskin seconded the motion, which passed unanimously by voice vote.

**STUDENT PRESENTATIONS**

Ms. Christine Hinojosa, Arlington High School Interim Principal, introduced Mr. John Grabowski and members of an Arlington High School jazz combo, who entertained the Board and audience with a jazz number as part of Arlington High School's art display at the District Office for the month of January. Immediately following, Ms. Hinojosa introduced Ms. Teri Bravomejia and advanced culinary arts students, who provided desserts for the Board and audience members, and shared an invitation to the Board for a dinner in their honor prior to the January 23 Board Meeting as part of School Board Recognition Month.

Mr. Will Nelson, Weston High School Principal, introduced Mrs. Julie Shaughnessy, teacher, and a student who shared a presentation about his project/problem based learning activity regarding water filtration.

**COMMENTS FROM AUDIENCE MEMBERS**

There were no comments from the audience.

**CONSENT AGENDA**

A. Budget Report
B. Personnel Report
C. Payroll Report – December 2016
D. Vouchers and Warrant

E. Adjusted Warrants

Director Duskin moved to approve the consent agenda as presented. Director McClure seconded the motion, which passed unanimously by voice vote.

**NEW BUSINESS**

**A. Bond Refunding - Briefing**

Ms. Deborah Borgens, Executive Director of Financial Services, introduced Mr. Jon Gores of D.A. Davidson, and Mr. Jim McNeill of Foster Pepper PLLC, who shared information and responded to questions from the Board regarding the refunding of the 2007 bonds.

**B. Resolution 17-01 State Guarantee – Refinancing of 2007 Bonds**

Director McClure moved to approve Resolution 17-01 as presented. Director Duskin seconded the motion, which passed unanimously by voice vote.

**C. Resolution 17-02 Delegation – Refinancing of 2007 Bonds**

Director Ghirardo moved to approve Resolution 17-02 as presented. Director Weiss seconded the motion, which passed unanimously by voice vote.

President Huleatt announced that the Board would be taking a short recess to sign the bond refinancing documents and that the meeting would be reconvened in approximately 5 minutes. The meeting was recessed at 7:08 pm.

At 7:14 pm, President Huleatt reconvened the meeting.

**D. Hazard Mitigation Plan - Briefing**

Mr. Ed Aylesworth, Director of Child Nutrition and Support Services, shared information and answered questions from the Board regarding the draft Hazard Mitigation Plan and the process for approval and finalization. The District is currently seeking public input through its website and during a public meeting scheduled for February 7, 2017 at 6:00 pm at the District Administration Office.

**E. Policy for Second Reading and Adoption**

- **Policy 4210 – Community Relations – Regulation of Dangerous Weapons - revise**

Dr. Chrys Sweeting, Superintendent, shared information and answered questions regarding this policy. Director McClure moved to approve Policy 4210 as presented for second reading and adoption. Director Weiss seconded the motion, which passed unanimously by voice vote.

**F. Policy for First Reading and Discussion of Related Procedure**

- **Policy 5010 – Personnel – Non-Discrimination and Affirmative Action – revise**
- **Proced 5010P – Personnel – Non-Discrimination and Affirmative Action – revise**

Mr. Mike Johnson, Executive Director of Human Resources, shared information and answered questions about Policy 5010 and Procedure 5010P. Following a lengthy discussion, the Board requested one amendment to the policy and suggested a few for the procedure. The policy will be presented for Second Reading and Adoption at the January 23 Board meeting.

F. **2016-2021 Affirmative Action Plan - Arlington School Dist. No. 16**

Mr. Mike Johnson, Executive Director of Human Resources, shared information and answered questions from the Board about the proposed 2016-2021 Affirmative Action Plan. The Board requested several minor amendments. Those revisions will be made. Director McClure moved to approve the Affirmative Action Plan as amended. Director Duskin seconded the motion, which passed unanimously by voice vote.

**SUPERINTENDENT'S REPORT**

Superintendent Sweeting acknowledged the amazing art in the hallway this month provided by
Arlington and Weston High Schools. The students are very creative and
talented!

Dr. Sweeting and Mr. Brian Lewis, Executive Director of Operations, shared undated information about the Study and Survey.

Dr. Sweeting reminded the Board of the Special Meetings/Workshops on January 19-20, 2017 in
La Conner, WA and a lunch order was
passed.

**COMMENTS FROM BOARD MEMBERS**

Board members shared general
comments.

**NEXT MEETINGS**

- Special Meeting/Workshop – Thursday, January 19, 2017, 7:00 pm
Dunlap Conf. Rm, Channel Lodge, 205 N First St, La Conner, WA 98257
- Special Meeting/Workshop – Friday, January 20, 2017, 8:30 am
Dunlap Conf. Rm, Channel Lodge, 205 N First St, La Conner, WA 98257
- Regular Business Meeting – Monday, January 23, 2017, 6:00 pm
Admin. Building Board Room, 315 N French Ave, Arlington, WA

**EXECUTIVE SESSION**

President Jeff Huleatt recessed the regular Business Meeting at 8:20 pm, stating that the Board would be convening in an Executive Session for consideration of a minimum price at which real estate will be offered for sale or lease. President Huleatt stated that the estimated time for the Executive Session would be 15 minutes and that, following the Executive Session, the regular meeting would be reconvened for the sole purpose of adjournment. The Executive Session convened at 8:26 pm. The Board Room was checked at 8:50 pm and there were no audience members. The Executive Session concluded at 9:02 pm.

**ADJOURN**

President Huleatt reconvened the regular meeting at 9:07 pm. With no further business to come before the Board, Director Duskin moved and Director McClure seconded the motion to adjourn. The motion was approved with a unanimous vote and the meeting was adjourned at 9:08 pm.

Dr. Jeff Huleatt
President
Board of Directors

Dr. Chrys Sweeting
Superintendent
Secretary to the Board

Date Approved: ____________________

# Community Forum Meeting

*Agenda*

ARLINGTON
Public Schools

## Hazard Mitigation Plan-Community Forum
## February 7, 2017
## Washington Room, District Office

**Norms**
- *Assume positive intent*
- *Be kinder than necessary*
- *Be prepared*
- *Honor time*
- *Be professional in all interactions*
- *Be fully present and engaged*

**District Essentials**
- *Every Child, Every Hour, Every Day*
- *Coherence - Aligning Our Work*
- *Professional Learning Communities/High Performing Teams*
- *Resource Accountability*
- *Positive, Professional Working & Learning Environment*

**Reflective questions for our time together:**
- *Will the Hazard Mitigation Plan do what it is intended to do?*
- *Is it doable?*

**Learning outcomes for this work:**
- *Any changes needed to add clarity to the plan*

| Time | Activity | Who? |
|---|---|---|
| *6:00 pm* | *Introductions* | *Brian* |
| *6:10* | *Overview* | *Ed* |
| *6:30* | *Review Plan and present comments* | *All* |
| *6:55* | *Wrap up* | *Ed* |
| | | |
| | | |
| | | |
| | | |
| | | |

*~ Educating all students, preparing and inspiring them to achieve their full potential ~*

## Minutes

No minutes were taken as no one from the community attended.

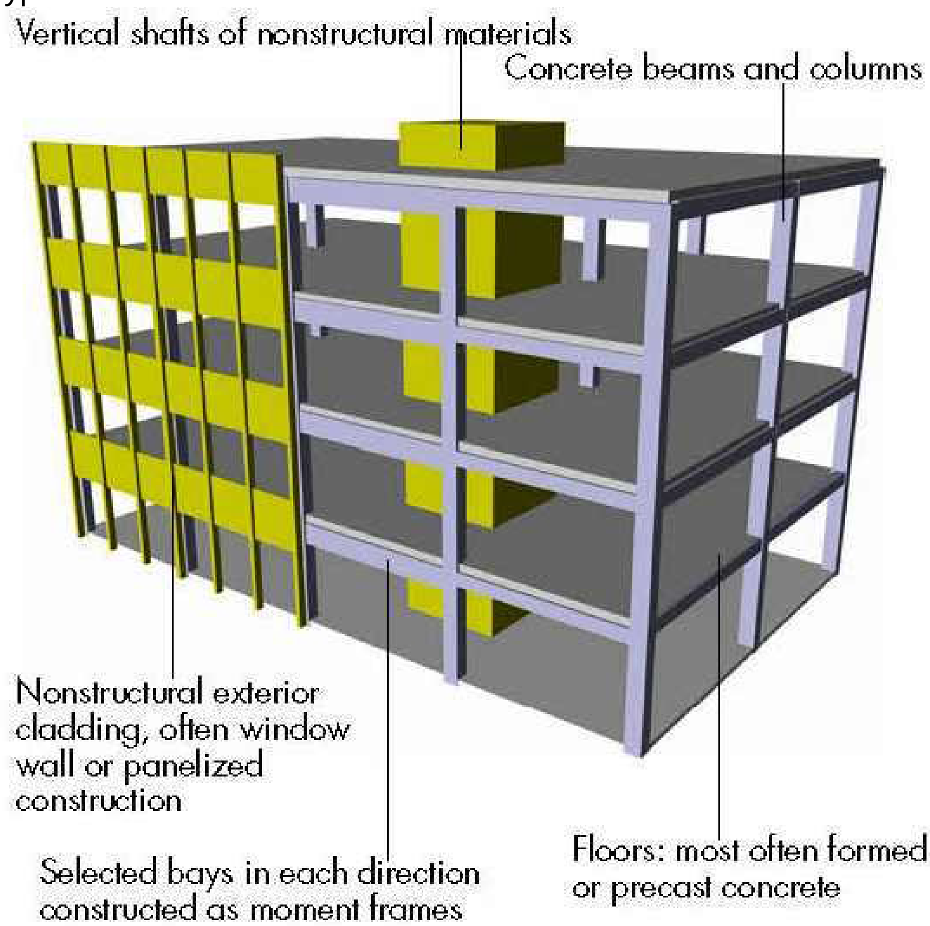
# APPENDIX D

# Area

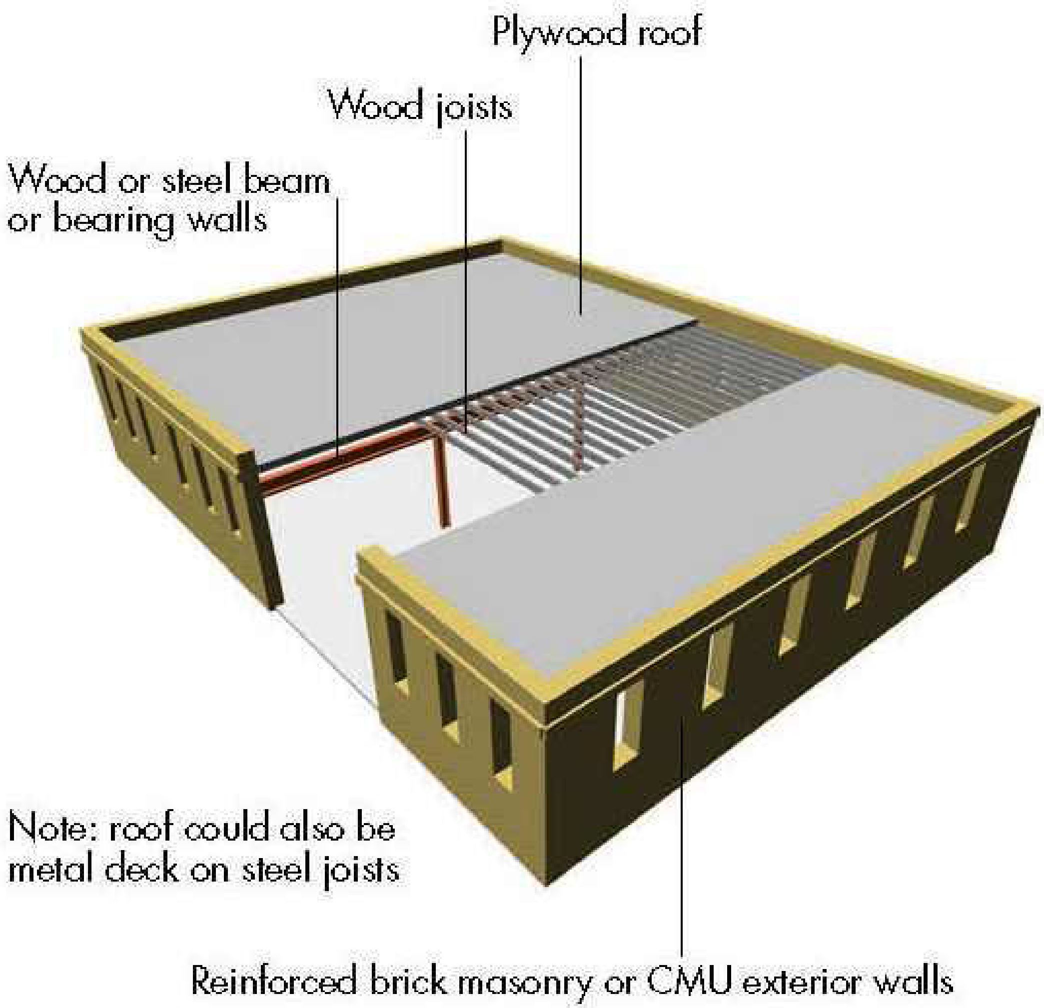
# Building Types

A classification of the structural type for a building which provides a building's strength to resist both gravity (vertical) and lateral (horizontal) forces on the building, including steel or concrete frames, weight bearing walls which may be concrete, masonry or wood, and horizontal members including roof and floor structures.
In order to correctly identify the level of seismic hazard, each building type for each area of the building needs to be correctly identified by building type. One building may have several different building types based on the year it was added or even by what it is used for. Different area for the building can be added and/or edited in the Building Inventory screen. Select the correct building type for each Area for the building. There are 28 possible area building types described below. Building "types" refer to the structural systems of the building not the exterior façade. For example, a wood frame building or concrete shear wall building may have a brick veneer, but the structural system is correctly identified as wood frame or concrete shear wall:

**C1L - Concrete Moment Frame Low-Rise – 1 to 3 Stories**
This building type has regular rectangular frame geometry like Building Type S1 (see below), but the beams and columns are concrete instead of steel. Floors are typically cast-in-place or precast concrete, but may be wood in older buildings. This is a common building type for older schools.

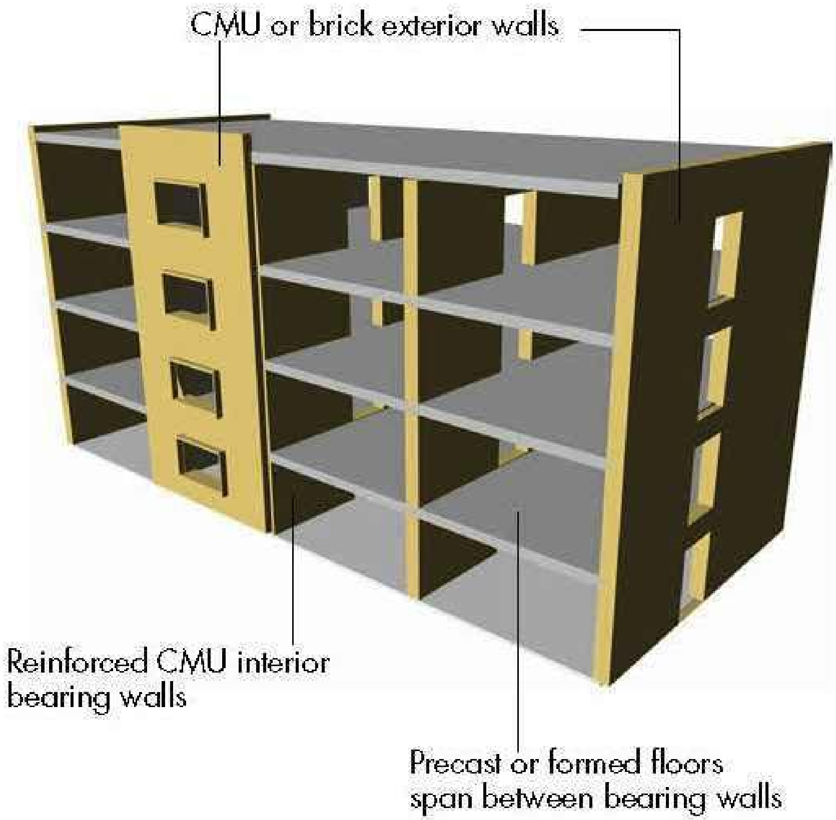


**RM1L - Reinforced Masonry Bearing Walls with Wood or Metal Deck Diaphragms**
**Low-Rise** – 1 to 3 stories
These buildings have bearing walls that consist of reinforced brick or concrete block masonry. The floor and roof framing consists of steel or wood beams and girders or open web joists and are supported by steel, wood or masonry columns. Diaphragms consist of straight or diagonal wood sheathing, plywood or un-topped metal deck and are flexible relative to the walls.
Building types RM1 and RM2 are distinguished by the materials used for floor and roof diaphragms. This is a common building type for schools.



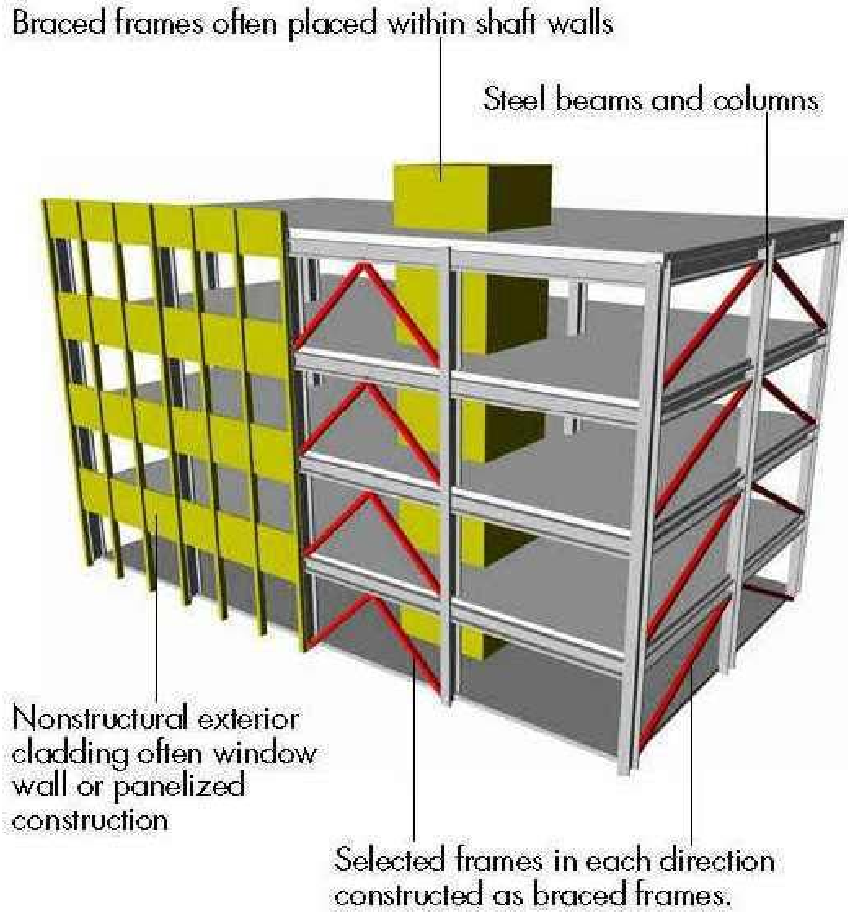
**RM2L - Reinforced Masonry Bearing Walls with Precast Concrete Diaphragms Low-Rise - 1 to 3 stories**

This building type is similar to RM1 buildings, except that the diaphragms consist of metal deck with concrete fill, precast concrete planks, tees or double-tees, without or without a concrete topping slab, and are stiff relative to the walls. Building types RM1 and RM2 are distinguished by the materials used for floor and roof diaphragms. This is a common building type for schools.



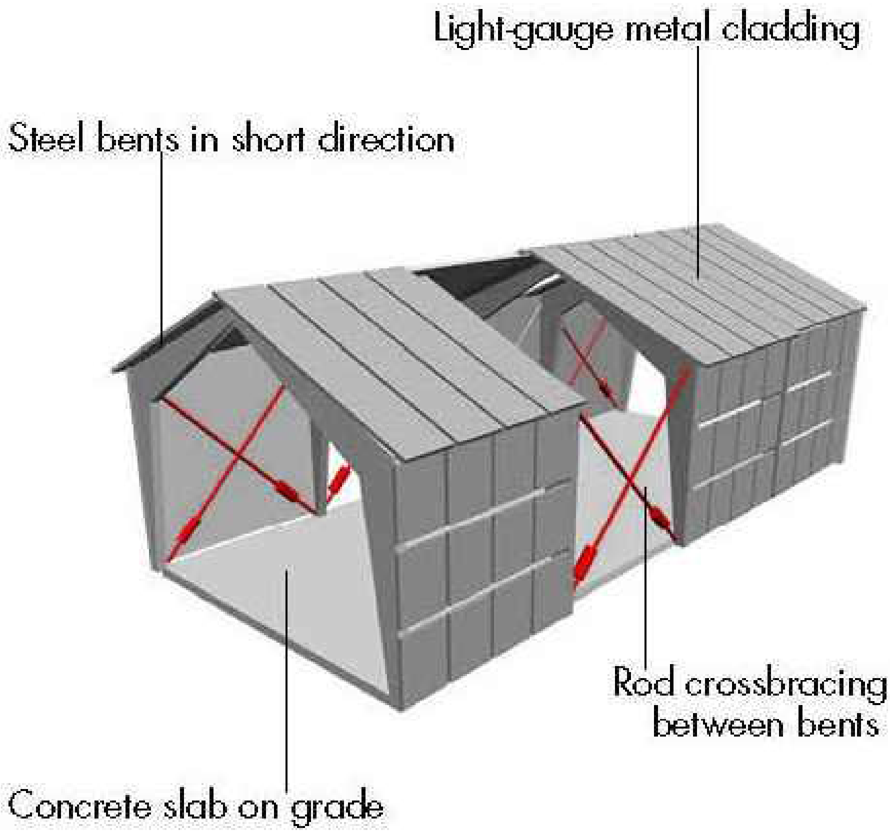
**S2L - Steel Braced Frame Low-Rise – 1 to 3 Stories**

This building type is characterized by a regular, rectangular frame of steel columns and beams with the addition of diagonal braces. The diagonal bracing may be visible on the building exterior or visible in window openings. This is not a common building type for schools, although some do exist.

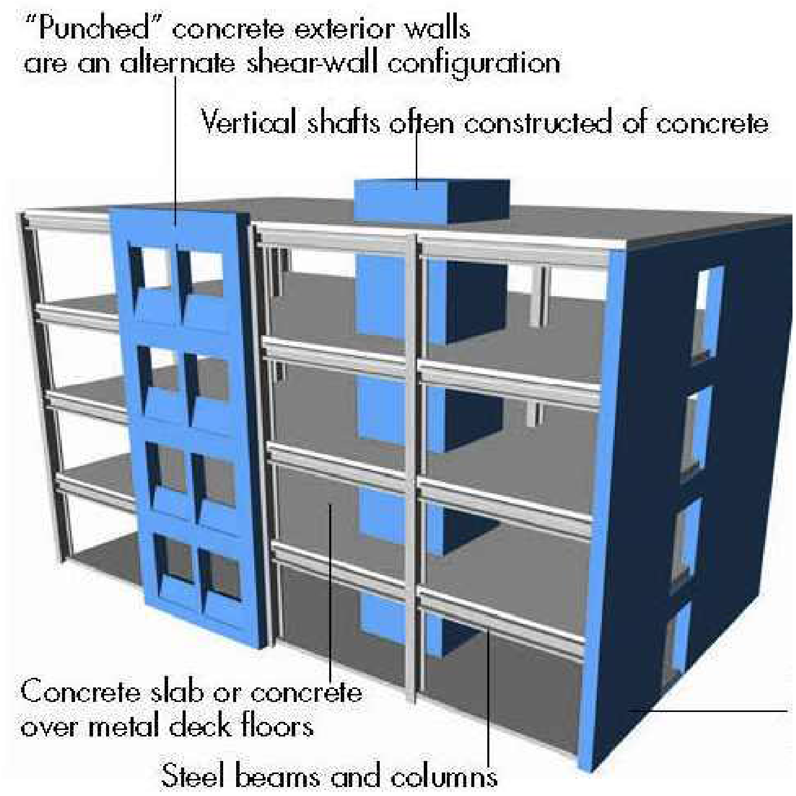


**S3 - Steel Light Frame – 1 story**

These buildings are one-story pre-engineered and partially prefabricated with light steel framing. The frames are assembled in the field and connected with bolts or welded joints. The roof and walls consist of lightweight metal, fiberglass or cementitious panels. These buildings are not common for schools, although some exist – typically for storage, maintenance or sports facilities.



**S4L - Steel Frame with Cast-in-Place Concrete Shear Walls Low-Rise –1 to 3 Stories**
The building type includes a steel frame with beams and columns along with concrete shear walls to provide lateral strength. The shear walls include walls in both directions of the building, but may or may not be continuous along the full length of all walls. The floors are typically concrete buy may be wood in older buildings. This is not a common building type for schools, but some do exist.



**W1 - Wood Light Frame** –
This building type is characterized by wood framing throughout the building including stud walls, joists and rafters. Floor and roof diaphragms may be straight wood, diagonal wood, tongue-and-grove-planks, plywood or oriented strand board. The first floor framing may be supported directly on a slab or perimeter foundation or raised on short cripple-wall studs or post-and-beam supports.
Exterior finish materials may be wood siding, metal siding, stucco or brick veneer. Interior partition walls are sheathed in plaster or gypsum drywall board.


***W2-Wood Frame Building:*** These can be large residential (apartments), commercial, and sometimes light industrial buildings with more than 5000 square feet.

**Portable** –Portable classrooms are factory built structures, usually in one or two pieces, which are assembled on site. Portables are most similar to W1, small wood frame building, but differ in some characteristics, especially the types of foundations used. Thus, for seismic risk assessments, portables are considered a separate building class.