2009

Multijurisdictional Hazards Mitigation Plan Five -Year Update

City of Shoreline
Shoreline Fire Department

Five-Year Update

City of Shoreline, Washington

7/20/2009

Shoreline City Council

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EXECUTIVE SUMMARY

This is Multijurisdictional Hazards Mitigation Plan updates the 2004 Shoreline Hazards Mitigation Plan and includes as an annex the Shoreline Fire Department (King County Fire District 4) HMP that was not included within the original Plan.

The update was driven by hazards thought significant by the Shoreline Emergency Management Council. The hazards ranking in 2009 was similar to those driving the 2004 plan with the exception that climate and flood hazards received greater emphasis in 2009. However earthquake hazards were thought most crucial in the original HMP and its update.

The 2004 City of Shoreline HMP included 28 action items. During the five years since adoption of the plan, Shoreline has completed all of the action items.

This update offers 8 broad action items to reduce hazard driven risks.

1. TARGET HIGHER RISK NEIGHBORHOODS FOR SPECIFIC RISK REDUCTION MEASURES
2. CONTINUE AND EXPAND THE DELIVERY OF RISK REDUCTION OUTREACH PROGRAMS BY CITY & FIRE STAFF, TO GENERAL POPULATIONS OF HOUSEHOLDS AND BUSINESSES.
3. INCREASE GIS CAPABILITY THROUGH PARTNERING WITH FIRE DEPARTMENT.
4. THE CITY AND FIRE DEPARTMENT WILL PARTICIPATE IN THE PLANNING/ASSESSMENT ACTIVITIES OF UTILITY SERVICE PROVIDERS.
5. ESTABLISH SAFE PLACES OF REFUGE WITHIN WALKING DISTANCE OF RESIDENTS
6. DEVELOP AND DELIVER BUSINESS OUTREACH PROGRAM.
7. RETROFIT OR REPLACE VULNERABLE CITY OWNED FACILITIES AND INFRASTRUCTURE.
8. REDUCE FLOOD DAMAGE WITHIN RONALD BOG COMMUNITY.

The 2009 update was the product of an extensive public process that took advantage of the quarterly and post event Emergency Management Council (EMC) 2004 plan maintenance activities. Numerous opportunities for involvement were used to involve all stakeholder including public meetings, distribution of materials and through a community survey hosted on the City website.

The updated risk assessment relied heavily on that included within the earlier plan. However, where better hazards or vulnerability information was available, it was used, and scenarios were re-written to reflect new data.

To determine and exploit capabilities, the 2009 HMP included a Strengths, Weaknesses, and Opportunities, Threat (SWOT) analysis. The SWOT analysis helped frame mitigation strategies. Of

particular importance, the process identified strengths in the Shoreline neighborhood associations, Fire Department and City personnel and active community organizations. These and other capabilities were made use of to advance the EMC goals to:

1. PROTECT PUBLIC HEALTH, WELFARE, AND PUBLIC SAFETY
2. MINIMIZE LOSSES TO EXISTING AND FUTURE PROPERTIES
3. ENCOURAGE COORDINATION AND COMMUNICATION AMONGST PUBLIC AND PRIVATE ORGANIZATION
4. ENSURE CONTINUITY OF CRITICAL FACILITIES AND CORRESPONDING OPERATIONS OF LOCAL GOVERNMENT
5. PROTECT AND ENHANCE ENVIRONMENTAL QUALITY

This 2009 plan update will be maintained through a process that continues the 2004 maintenance plan and ensures that the City of Shoreline HMP remains a current , comprehensive and useful document throughout the five-year update cycle.

ORIGINAL

RESOLUTION NO. 293

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF SHORELINE WASHINGTON ADOPTING THE SHORELINE MULTIJURSIDICTIONAL HAZARD MITIGATION PLAN (HMP) UPDATE FOR 2009-2014 AS APPROVED BY THE FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA)

WHEREAS, Section 322 of the Federal Disaster Mitigation Act of 2000 requires local government agencies to develop and submit an All-Hazards Mitigation Plan in order to receive future Hazard Mitigation Grant Program Funds; and

WHEREAS, natural and man-made hazard events pose threats to lives and cause damages to property within the City of Shoreline; and

WHEREAS, staff working with technical experts has used available technologies, information, and historical documents to conduct a comprehensive risk reduction analysis resulting in the preparation of the City of Shoreline HMP Update; and

WHEREAS, the HMP Update formalizes that City's comprehensive efforts to make the City safer through preventing damage in the built environment; and

WHEREAS, the HMP builds on the objectives and actions established in the 2004 HMP and the City of Shoreline's Comprehensive Plan; and

WHEREAS, the HMP has been reviewed by all relevant departments, boards, committees, and the Governor's Office of Emergency Services and FEMA; and

WHEREAS, approval of the HMP Update by FEMA establishes eligibility for the City to pursue Hazard Mitigation funds; now therefore

BE IT RESOLVED that the Shoreline City Council adopts the City of Shoreline Hazards Mitigation Plan filed under Clerk's Receiving No. 5574 in accordance with the Federal Disaster Mitigation Act of 2000.

ADOPTED BY THE CITY COUNCIL ON NOVEMBER 23, 2009.

Mayor Cindy Ryu

ATTEST:

Scott Passey, CMC
City Clerk

U.S. Department of Homeland Security
Region X
130 228th Street, SW
Bothell, WA 98021-9796

FEMA

December 2, 2009

Honorable Cindy Ryu
Mayor, City of Shoreline
17500 Midvale Avenue N
Shoreline, Washington 98133-4921

Dear Mayor Ryu:

The U.S. Department of Homeland Security's Federal Emergency Management Agency (FEMA) has approved the ***City of Shoreline Multijurisdictional Hazards Mitigation Plan*** as a multi-jurisdictional local plan as outlined in 44 CFR Part 201. With approval of this plan, the following entities are now eligible to apply for the Robert T. Stafford Disaster Relief and Emergency Assistance Act's hazard mitigation project grants through December 2, 2014:

City of Shoreline

Shoreline Fire Department
(King County Fire District No.4)

The plan's approval provides the above jurisdictions eligibility to apply for hazard mitigation projects through your State. All requests for funding will be evaluated individually according to the specific eligibility and other requirements of the particular program under which the application is submitted. For example, a specific mitigation activity or project identified in the plan may not meet the eligibility requirements for FEMA funding, and even eligible mitigation activities are not automatically approved for FEMA funding under any of the aforementioned programs.

Over the next five years, we encourage your communities to follow the plan's schedule for monitoring and updating the plan, and to develop further mitigation actions. The plan must be reviewed, revised as appropriate, and resubmitted for approval within five years in order to continue project grant eligibility.

If you have questions regarding your plan's approval or FEMA's mitigation grant programs, please contact our State counterpart, Washington Emergency Management Division, which coordinates and administers these efforts for local entities.

Sincerely,

Mark Carey, Director
Mitigation Division

cc: Beverly O'Dea, Washington Emergency Management Division

KM:bb

www.fema.gov

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CHAPTER 1 INTRODUCTION AND ADOPTION

BACKGROUND

This is Multijurisdictional Hazards Mitigation Plan updates the 2004 Shoreline Hazards Mitigation Plan and includes as an annex the Shoreline Fire Department (King County Fire District 4) HMP that was not included within the original Plan. The Fire Department HMP draws upon the risk analysis included with the Shoreline Plan but is written as a freestanding document to make it easier to read by the general public. Other EMC member organizations were asked to be included within this Multi-jurisdictional Plan, but for various reasons chose not to have their agency plans be included within this document.

Local Hazard Mitigation Plan Requirements

Requirement § 201.6: The local mitigation plan is the representation of the jurisdiction's commitment to reduce risks from natural hazards, serving as a guide for decision makers as they commit resources to reducing the effects of natural hazards. Local plans will also serve as the basis for the state to provide technical assistance and to prioritize project funding.

The Federal Disaster Mitigation Act (DMA) of 2000 (Public Law 106-390) commonly known as the 2000 Stafford Act amendments were approved by Congress on October 10, 2000. This Act requires state and local governments to develop hazard mitigation plans as a condition of federal grant assistance and to update these plans every five years. Prior to 2000, federal legislation provided funding for disaster relief, recovery, and some hazard mitigation planning. The DMA improves upon the planning process to emphasize the importance of mitigation; encouraging communities to plan for disasters before they occur.

Hazard mitigation can be considered any action taken to permanently eliminate or reduce the long-term risk to human life and property from natural and human caused hazards. This is an essential element of emergency management along with preparedness, response and recovery. Disasters can produce a significant impact on communities when they occur. They can destroy or damage life, property, infrastructure, local economies and the environment.

This Hazard Mitigation Plan (HMP) helps protect the health, safety, economic and environmental interests of residents. Careful, long-term pre-disaster planning can help to reduce the impacts of natural hazards and increase a community's resilience through planning, awareness and implementation of mitigation actions. Fewer lives, homes and businesses will be lost and the disruption of a disaster event to the community will be lessened if hazard mitigation planning is utilized. Ultimately, a community that is hazard resilient is more likely to remain intact economically, structurally, socially and environmentally, even when a disaster does occur. This plan is an update to the 2004 City of Shoreline HMP.

The basis of the HMP is the City of Shoreline Hazard Inventory and Vulnerability Analysis (HIVA) completed in 2004 and updated in 2009. Using the HIVA as a starting point, this HMP defines each hazard, assesses the risk the hazard poses to residents of Shoreline and defines the specific long-term mitigation actions that the city can take to reduce loss in the event of a hazard event. This update also incorporates an evaluation of action items included in the 2004 plan.

Hazard identification is the systematic use of all *available* information to determine what types of and when disasters may affect a jurisdiction, how often these events can occur and the potential severity of their consequences. Vulnerability analysis refers to the process used to determine the impact these events and their collateral effects may have on the people, property, environment, economy and lands of a region.

The Federal Emergency Management Agency (FEMA) defines mitigation as "actions that reduce or eliminate the long-term risk to people and property from the effects of hazards," (FEMA 2000). Mitigation can be structural or non-structural earthquake retrofit programs, city code that prohibits new development in floodplains or coalition building among organizations to improve their ability to educate the public about risk.

The updated City of Shoreline HMP will serve as a mechanism for the city to reduce the risk and impact of disaster events, allocate appropriate resources and to help set priorities and standards to ensure the safety of the public.

PURPOSE AND MISSION

The purpose of this document is to provide an update to the 2004 City of Shoreline HMP which compiled and expanded upon existing information about natural hazards that have the potential to affect large areas or populations within the City of Shoreline. The HMP is intended to serve as a basis for city-level emergency management plans and programs, as well as to assist municipal jurisdictions, school districts and private businesses in the development of similar documents focused on local hazards.

This document will help to make an important first step toward a city that is as resilient as possible and will cover each of the hazards affecting the City of Shoreline. Table 1-1 provides a list of the hazards included in the 2004 HMP and the hazards included in this update in order of importance chosen by the community. Climate Change was not included within the 2004 Plan, The Shoreline Emergency Management Council agreed to include climate change as an element of the severe weather hazard discussion at their November 12th 2008 meeting.

Table 1-1 2004 and 2009 Hazard Ranking

Rank No.	2004 Hazards	2009 Updated Hazards
1	Earthquakes	Earthquakes
2	Hazardous Materials	Severe Weather and Climate Change
3	Severe Weather	Flooding
4	Landslides/Sinkholes	Landslides & Sinkholes
5	Flooding	Wildland Fire
6	Wildland Fire	Volcano
7	Volcano	Hazardous Materials

8	Tsunami/Seiche	Tsunami/Seiche

The City of Shoreline HMP defines each hazard, assesses the risk the hazard poses to Shoreline, provides long-term mitigation actions and implementation strategies that the city should consider to reduce loss in the event of a hazard event.

2004 ACTION ITEM STATUS AND 2009 UPDATED ACTION ITEMS

In the 2004 City of Shoreline HMP, Shoreline had 28 action items that were selected. During the five years since adoption of the plan, Shoreline has completed all of the action items. Many of these items are activities that are being continued. Below provides a list of the 2004 action items, when the item was initially completed and if it is an ongoing activity.

Table 1-2 2004 Action Item Status

No.	Action Item/Mitigation Strategy	Ongoing	Planning Mechanism used to complete (if applicable)	Date Completed
M-1	Create a full time position in the City of Shoreline for an Emergency Management Coordinator		Shoreline Municipal Code (Ord. 328 § 1, 2003; Ord. 103 § 4, 1996)	June 2004
M-2	Create a community wide comprehensive education program to educate the public about hazards and hazard mitigation	X	Program developed by Emergency Management Coordinator resulting in on-going comprehensive community education program with out reach to individuals by attending numerous community events and meetings to give out information; to neighborhoods, using Map Your Neighborhood Tool, establishing Ready Businesses, School Safety and establishing a Faith-based outreach effort. For specific numbers of meetings etc contact EMC for annual reports.	2005
M-3	Create and maintain a partnership with utility providers to ensure that the utility infrastructure serving Shoreline is retrofitted or built to standards that make them less vulnerable in a hazard event including critical infrastructure protection	X	Mutual Aid Agreements with Shoreline Water, SPU, Seattle City Light, and Ronald Wastewater	2005
M-4	Create and maintain a partnership with Washington State Department of Transportation (WSDOT) to ensure that the I-5 overpasses located in Shoreline are retrofitted to current seismic standards within a reasonable	X	WSDOT addresses all bridges and overpasses on I-5 to ensure they have been retrofitted with only one	October 2007

	time frame		remaining to be retrofitted by 2015.	
M-5	Implement non-structural retrofitting in city facilities and provide incentives for non-structural retrofitting for privately owned structures throughout the city	X	All City owned or operated facilities have had non-structural retrofitting completed and is done automatically when offices are moved.	2007
M-6	Identify critical community facilities and infrastructure that are without back up power generators	X	All facilities were located and identified.	2007
M-7	Identify and assess critical and essential city infrastructure and facilities		Completed an inventory report of critical and essential city infrastructures and facilities (Available Office of Emergency Management Coordinator)	2008
M-8	Assure that the public is informed of the necessity of maintaining a 3-day supply of food and water, along with basic first aid and medical supplies.	X	Active in the 3Day3Way County campaign in King County	2005
M-9	Provide incentives for voluntary structural retrofitting of older structures on vulnerable soils	X	City participation in the regional Project Impact partnership retrofit program	2007
M-10	Improve/expand storm water drainage, dams, detention and retention system capabilities	X	Surface Water Master Plan completed	2005
M-11	Identify critical city facilities and infrastructure and acquire back up power generators for those currently without	X	All City owned and operated facilities have provisions for alternative power have been worked out with either the placement of an new generator and the acquisition of portable generator that can be used at those most critical sites if needed.	2009
M-12	Identify critical government functions and establish backup operations for these functions	X	COOP/COG plan completed in 2009	2009
M-13	Educate homeowners, developers and business owners about how to reduce impacts of urban flooding	X	Storm Water Master Plan calls for this activity on an ongoing basis and does Low Impact Development Manual. In last two years there have been specific targeted outreach efforts associated	2007

			with Ronald Bog Flooding Mitigation Project.	
M-14	Provide incentives for non-structural retrofitting of hazardous materials containment throughout the city	X	On-going programs address this issue. Examples are: 2 X a year city wide recycle event Business recycle event annually Ensuring there are spill containment bags in trucks Staff assigned to do on going environmental education classes Battery Recycle program Joint efforts with other jurisdictions to assist w/solutions for downstream flooding issues.	2007
M-15	Create and maintain a partnership between City of Shoreline Emergency Services and Washington State Public Health Laboratories so there is coordination during and immediately after a disaster	X	Health Laboratory has a member on the Emergency Management Council (Ord. 328 § 1, 2003; Ord. 103 § 4, 1996). In addition, the EMC sits on the Stakeholder committee for the Washington State Public Health Lab.	2005
M-16	Create and maintain partnerships with educational and care facilities	X	School Representative and Shoreline Community Services on Emergency Management Council; Ord. 328 § 1, 2003; Ord. 103 § 4, 1996). In addition, the EMC is an active member on the Shoreline School District Safety Committee.	2006
M-17	Institute low impact development regulations for new developments as well as re-development projects	X	Adopted Department of Ecology Low Impact Development Manual, 2005 King County Surface Water Design Manual, 2009	January 2009
M-18	Create and maintain a partnership between the City of Shoreline and the Shoreline Fire Department so that there is coordination in implementing mitigation measures as well as coordination during and immediately after a disaster	X	Fire Department on Emergency Management Council; Ord. 328 § 1, 2003; Ord. 103 § 4, 1996)	2005

M-19	Create and maintain a partnership between the City of Shoreline and the Shoreline School District so that there is coordination in implementing mitigation measures as well as coordination during and immediately after a disaster	X	School Representative on Emergency Management Council; Ord. 328 § 1, 2003; Ord. 103 § 4, 1996)	2005
M-20	Create and maintain a partnership with Snohomish County	X	County member of EMC and Shoreline member of County Committee.	2005
M-21	Reassess the City of Shoreline evacuation and primary response routes	X	Comprehensive Emergency Management Plan	2005
M-22	Educate business owners about potential hazards and hazard mitigation	X	Hired Business Liaison Coordinator. Ongoing education request driven. Recent efforts have been to introduce the Open for Business Tool kit as well as the State of Washington Disaster Resistant Business Toolkit.	2007
M-23	Educate private homeowners about how to implement measures to reduce impacts of wildland fires	X	City – Wildland fire preparedness measures Included in City "Preparing for Hazards" citizen handout Fire Department – Distributed wildfire prevention handouts upon request and at neighborhood Council meetings	2005
M-24	Utilize the most current data and technology to develop a work program to regulate development and re-development of NEHRP E soils	X	Provision requirements are an integral component of currently adopted building codes under SMC Title 15. State adoption of 2006 I-codes effective July 2007 includes further refinements.	2005
M-25	Target code enforcement for abatement of nuisance vegetation on both City right-of-ways and public property	X	City Tree Exemption Code (20.50.310)	2005
M-26	Utilize Geographic Information Systems (GIS) in decision-making processes	X	Not Applicable but is an ongoing business decision for the City of	2005

			Shoreline	
M-27	Utilize the most current data and technology when regulating landslide areas	X	Shoreline Municipal Code (Title 15)	2006
M-28	Remove the Robinson Water Tower		Not Applicable as it was removed years ago.	2004

Below are the mitigation items selected during the 2009 update to the Shoreline HMP (see Table 1-3). Many of the ongoing action items from the 2004 HMP have been consolidated to create a more cohesive structure to the updated version of the HMP.

Table 1-3 2009 Action Items

No.	Action Item/Mitigation Strategy
1	Target higher risk neighborhoods for specific risk reduction measures.
2	Continue and expand the delivery of risk reduction outreach programs by City and Fire staff, to general populations of households and businesses.
3	Increase GIS capability through partnering with Fire Department.
4	The City and Fire Department will participate in the planning/assessment activities of utility service providers.
5	Establish safe places of refuge within walking distance of residents.
6	Develop and deliver business outreach program.
7	Retrofit or replace vulnerable City owned facilities and infrastructure.
8	Reduce flood damage throughout the Ronald Bog community.

Greater detail on each 2009 updated action item is provided in Chapter 7. Table 1-4 shows the how 2004 plan has been updated for 2009.

Table 1-4 - What Has Changed Since the 2004 Plan

Chapter	2004 HMP	2009 HMP Update Changes	Reasons for Change
1 Introduction	Introduction reflected the 2004 Plan	Introduction was changed to reflect the 2009 Plan	Introduce Plan content in 2009 update.

2	Community Profile	Community profile Information reflected that available in 2004.	Community profile Information was updated where more current was available. New Census Tract and block census data was not available. Data from US Bureau of the Census, "2005-2007 American Community Survey, Housing Characteristics was used where appropriate.	Changes were made to make HMP current advance analysis. Narratives were shortened to make the document more readable
3	Planning Process	2004 plan maintenance activities (quarterly and post event Emergency Management Council (EMC)) drove the 2009 public process.	The 2009 HMP Update built upon EMC activities. The 2009 Update initiated an expanded public involvement in the planning process throughout the development of the plan. (See document for details.)	The planning update process required an expanded process to assure input during plan development.
4	Risk	Risk analysis requiring additional analyses by hazard is as follows (as hazards ranked in 2004 Plan) • Earthquakes (new information available) • Hazardous Materials (analysis based on 2004 Information) • Severe Weather (new information available) • Landslides/Sinkholes (analysis based on 2004 information • Flooding (analysis based on 2004 information) • Wildland Fire (analysis based on 2004 information). .	Changes in risk analysis by hazards (as hazards ranked in 2009) • Earthquakes (New analysis required, HAZUS run with revised assumptions) • Severe Weather and Climate Change (Revised data available) • Flooding (Assessment based on 2004 information) • Landslides & Sinkholes (Assessment updated, based on 2004 information) • Wildland Fire (Assessment updated, based on 2004 information) • Volcano (Assessment	Risk did not change between 2004 and 2009, but new information and perceptions of risk did change.
5	Risk Rating	In the 2004 Shoreline HMP, risk was defined as the product of the frequency of a damaging hazard event times the impact. Capabilities were presented in the	The 2009 HMP incorporates a Strengths, Weaknesses, Opportunity and Threat (SWOT) analysis. SWOT Information was gathered at earlier stakeholder meetings. Results were recorded and reviewed and discussed at subsequent meetings.	SWOT analyses have received wide acceptance domestically and internationally

		earlier plan but not factored into the risk assessment.		
6	Goals and Objectives	The Emergency Management Council determined that the goals used to drive the 2004 Hazards Mitigation plan did not need amending and were approved for the 2009 HMP Update.	2004 Goals and Objectives were assessed, but the EMC felt t hat no change was necessary for the Update.	No change in update
7	Mitigation Strategies and Implementation	Action Items include within this update contain new and continued item.	Action items are listed in Chapter 5. Each is listed as to whether they are new or were included within the 2004 HMP. All items, new and updated 2004 items, were prioritized was based on new 2009 risk, benefit cost review information, and importance to the life and safety of the Shoreline community. The 2009 planning team verified the results of this process through interviews with the EMC, knowledgeable local officials and technicians.	The EMC determined that 2009 priorities, where new or continued items, be ranked with the context of all 2009 Action Items.
8	Plan Maintenance	The Emergency Management Council was responsible for plan maintenance under the overall direction of the Emergency Management Coordinator	The Emergency Management Council will remain responsible for plan maintenance under the overall responsibility of the Emergency Management Coordinator.	No change in update

POLICY FRAMEWORK FOR WASHINGTON

Washington State Mitigation Policy identifies a commitment to hazard mitigation planning in order to reduce the impact of disasters and ensure that communities in Washington State are less vulnerable to impacts of hazards. The Washington State Legislature and the Governor have instituted a program to provide matching fund support for eligible applicants of the Hazard Mitigation Grant Program (HMGP)

(http://www.emd.wa.gov/grants/grants_hazard_mitigation.shtml). There are also other state programs that have become available that can help aid mitigation strategies and reduce the impact of disasters.

PLAN CRITERIA AND AUTHORITY

This document provides information associated with the main disaster events affecting the City of Shoreline. This plan meets requirements of the DMA 2000 and the Washington Administrative Code (WAC 118-30-060 (1)) and is the basis for the City of Shoreline hazard mitigation planning efforts.

The DMA 2000 requires that for all disasters declared on or after November 1, 2004, all jurisdictions must have an adopted and FEMA approved HMP in place to be eligible for future hazard mitigation grant funds. This plan includes the following:

- Hazard Identification
- Hazard Mitigation Plan Goals
- Hazard Event Profile
- Vulnerability Assessment
- Identification and Analysis of Mitigation Measures
- Monitoring, Evaluating and Updating the Plan
- Implementation through Existing Programs
- Continued Public Involvement

This document falls under the jurisdiction of the Shoreline Emergency Management Council. The council provides oversight to emergency management activities and those ordinances, resolutions, contracts, rules and regulations that are necessary for emergency management (City of Shoreline Ord. 328 § 1, 2003; Ord. 103 § 5, 1996).

RELATED DOCUMENTS

Shoreline Comprehensive Plan and Master Plans: http://www.cityofshoreline.com/index.aspx?page=174

Comprehensive Emergency Management Plan: http://www.cityofshoreline.com/index.aspx?page=48

Shoreline Municipal and Development Code: http://www.cityofshoreline.com/index.aspx?page=97

King County Hazard Mitigation Plan:
http://www.kingcounty.gov/safety/prepare/EmergencyManagementProfessionals/PlansandPrograms/RegionalHazardMitigationPlan.aspx

State of Washington Military Department, Emergency Management Division, Hazard Mitigation Plan:
http://www.emd.wa.gov/plans/washington_state_hazard_mitigation_plan.shtml

State of Washington Department of Ecology Shoreline Management Act:
http://www.ecy.wa.gov/programs/sea/SMA/index.html

FEMA: http://www.fema.gov/about/divisions/mitigation.shtm;
http://www.fema.gov/plan/mitplanning/index.shtm

CHAPTER 2 COMMUNITY PROFILE

Community profile Information for this 2009 Plan was updated where more current was available and narratives were shortened to make the document more readable

HISTORICAL OVERVIEW

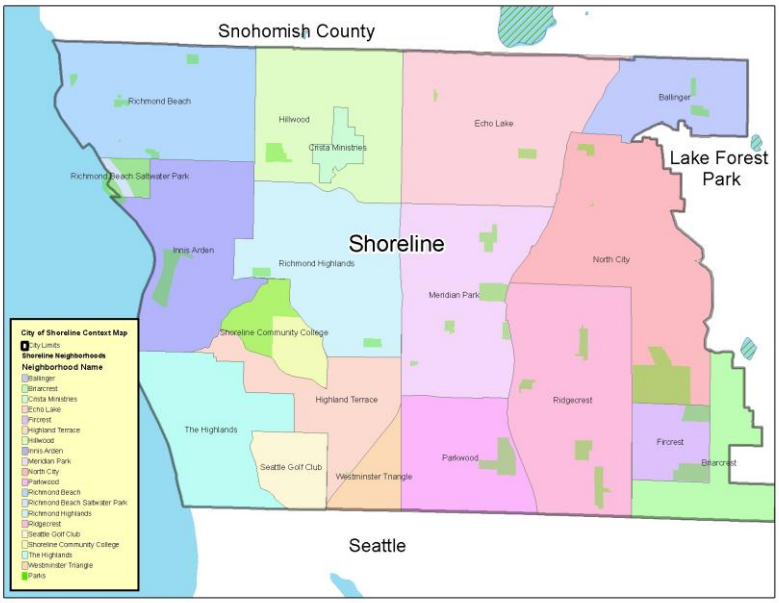
Development patterns in the City of Shoreline were influenced by Seattle becoming King County's commercial center. Suburban development began after the turn of the century due to expanding transportation networks. The trans-continental railroad tracks, Seattle- Everett Interurban line and the brick-surfaced North Trunk Road made it easier to travel to and from Shoreline and spurred suburban development. During the early twentieth century, Shoreline attracted some large developments and commercial centers formed around the Interurban stops. After the end of World War II (WWII), there was tremendous demand for family housing. In the 1940's, large housing developments formed and business leaders and residents began to see Shoreline as a unified region.

In 1949, the name "Shoreline" was used for the first time and described a community running from the Puget Sound shore to the Lake Washington shore and from the Seattle City line to the Snohomish County line. The City of Shoreline was incorporated on August 31, 1995 (City of Shoreline 1997).

GEOGRAPHICAL SETTING

The City of Shoreline is situated in the northwestern corner of King County along the shores of Puget Sound. Shoreline is bounded by Lake Forest Park to the east, Seattle to the south, Puget Sound to the west and Snohomish County to the north. Shoreline covers 11.74 square miles and is Washington's thirteenth most populated city with a population of about 53, 000 people. Figure 2-1 shows a general vicinity map for the City of Shoreline.

Figure 2-1 Vicinity Map



RIVERS AND STREAMS

Shoreline is drained by a small perennial stream on the west, Boeing Creek, which flows through the steep bluffs and into Puget Sound and two other minor streams, McAleer Creek and Thornton Creek, which flow into Lake Washington.

MOUNTAINS AND VOLCANOES

The Cascade Range is a 1,000-mile long chain of volcanoes, which extends from northern California to southern British Columbia. The Cascade Range is located to the east of Shoreline. However, Shoreline does not lie within any basin that would drain any lahars or mudflows from the nearby volcanoes. Nonetheless it would be affected by tephra or an ash fall from either a Mount Rainier or Glacier Peak eruption.

SOILS AND GEOLOGY

About 14,000 years ago the Vashon Glacier was covering Shoreline with nearly 3,000 feet of ice. The glacier carved out a trough and when it melted the sea level rose 300 feet, filled the trough, and created Puget Sound. Much of the soil in King County was left behind by the glacier. The top layer is Vashon till and can be found to depths up to 30 feet. Below Vashon till is Esperance sand and then Lawton clay. Vashon till is a stable mix of rocks, dirt, clay and sand that has the consistency of concrete. Esperance sand is a permeable mixture of sand and gravel. Lawton clay is an impermeable layer of clay, which is made up of fine sediments and large boulders (KCDEM, http://www.kingcounty.gov/safety/prepare.aspx).

CLIMATE

The City of Shoreline has the temperate climate typical of Western Washington. Summers are dry with mild temperatures, and winters are rainy with occasional snow. In Shoreline, the average temperature for January is 39.7 Fahrenheit (F) and 75 Fahrenheit for the average July high[1]. Average annual rainfall is 38.27 inches and average annual snowfall is 11.7 inches[2].

DEMOGRAPHICS

According to the 2005 to 2007 American Community Survey the population of Shoreline has remained steady going from 53,025 in the 2000 census to 52,547 for the 3-year survey. With infill development in Shoreline there are an increasing number of potentially vulnerable people, including:

- Increased percentage of older residents and residents with special needs
- Increased racial, ethnic and cultural diversity
- Increased percentage of residents living on fixed incomes

Hazard-related plans must consider the demographics of the communities they seek to protect. Some populations experience greater risk from hazard events, not because of their geographic proximity to the hazard, but because of decreased resources and/or physical abilities. Elderly people, for example, may be more likely to be injured in a disaster and are also more likely to require additional assistance after a disaster.

Research has shown that people living near or below the poverty line, the elderly and especially older single men, the disabled, women, children, ethnic minorities and renters have all been shown to experience more severe effects from disasters than the general population.

Vulnerable populations may vary from the general population in risk perception, living conditions, access to information before, during and after a hazard event, their capabilities during a hazard, and in access to resources for post-disaster recovery. Despite the fact that they often disproportionately experience the effects of a disaster, vulnerable populations are rarely accounted for in the current hazard mitigation planning process. There is a need for increased awareness of these differences. The remainder of this section will detail the numbers of potentially vulnerable populations residing in Shoreline. The demographic information for Shoreline is based on the 2005 to 2007 American Community Survey 3-Year Summary by the US Census Bureau.

INCOME

[1] http://www.weather.com/weather/wxclimatology/monthly/graph/98133?from=36hr_bottomnav_undeclared

[2] City of Shoreline, http://www.cityofshoreline.com/index.aspx?page=44)

Impoverished people may experience greater results from disasters than members of the general population. In the United States (U.S), individual households are expected to use private resources to prepare for, respond to and recover from disasters to some extent. This expectation means that households living in poverty are automatically disadvantaged when confronted by hazards. Additionally, households living below the poverty line typically occupy the more poorly built and inadequately maintained housing of any given community. Mobile or modular homes, for example, are more susceptible to damage in hurricanes, tornadoes and floods than other types of housing. In urban areas, households living below the poverty line often live in older houses and apartment complexes, which are more likely to be made of unreinforced masonry, a building type that is particularly susceptible to damage during earthquakes. In general, households living below the poverty line are more likely to die as a result of a disaster because they tend to live in older or poorly constructed homes located in more hazardous areas such as floodplains and they are less likely to fully recover after one (Blaikie et al. 1994).

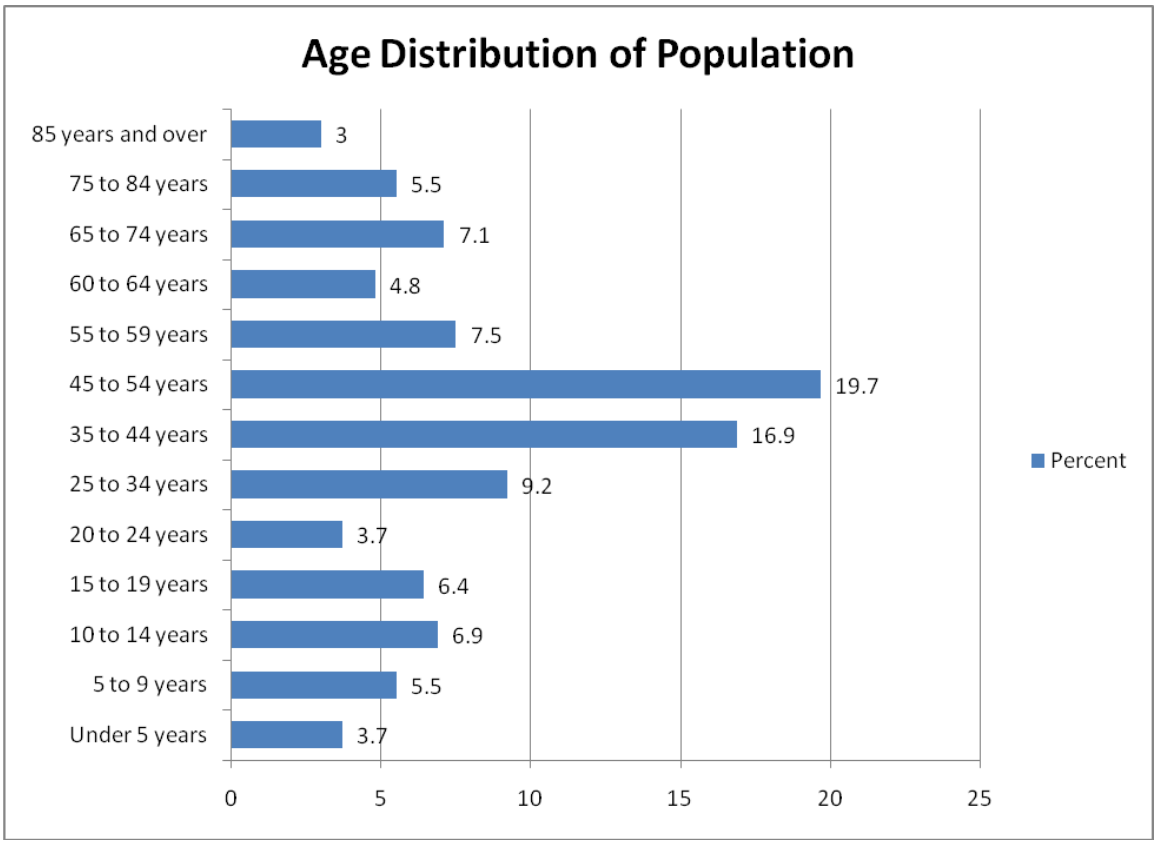
The 2005 to 2007 per capita income for families in Shoreline was $31,935. The median household income was $61,238. About 8.2% of Shoreline residents are below the poverty line (meaning they spend more than 1/3 of income on an economy food budget). Of the 4,309 people living below poverty in Shoreline, about 7.5% are under the age of 18 and about 8.7% are 65 or older.

AGE DISTRIBUTION

The vulnerability of elderly populations can vary quite significantly based on health, age, and economic security. However, as a group, the elderly are more apt to lack the physical and economic resources necessary for response, and are more likely to suffer health-related consequences and be slower to recover (Morrow 1999). They are more likely to be vision, hearing, and/or mobility impaired, and more likely to experience mental impairment or dementia. Furthermore, they are more likely to live in assisted living facilities, where emergency preparedness occurs at the whim of operators (California Office of Emergency Services 1992). Certainly, the elderly require specific planning attention, an especially important consideration given the current aging of the American population.

According to US Census Bureau data, 15.6% of Shoreline's population is 65 or older. Of this 14.5%, 2,904 people or 49.8% have disabilities. Figure 2-2 shows age distribution for Shoreline.

Figure 2-2 City of Shoreline Age Distribution

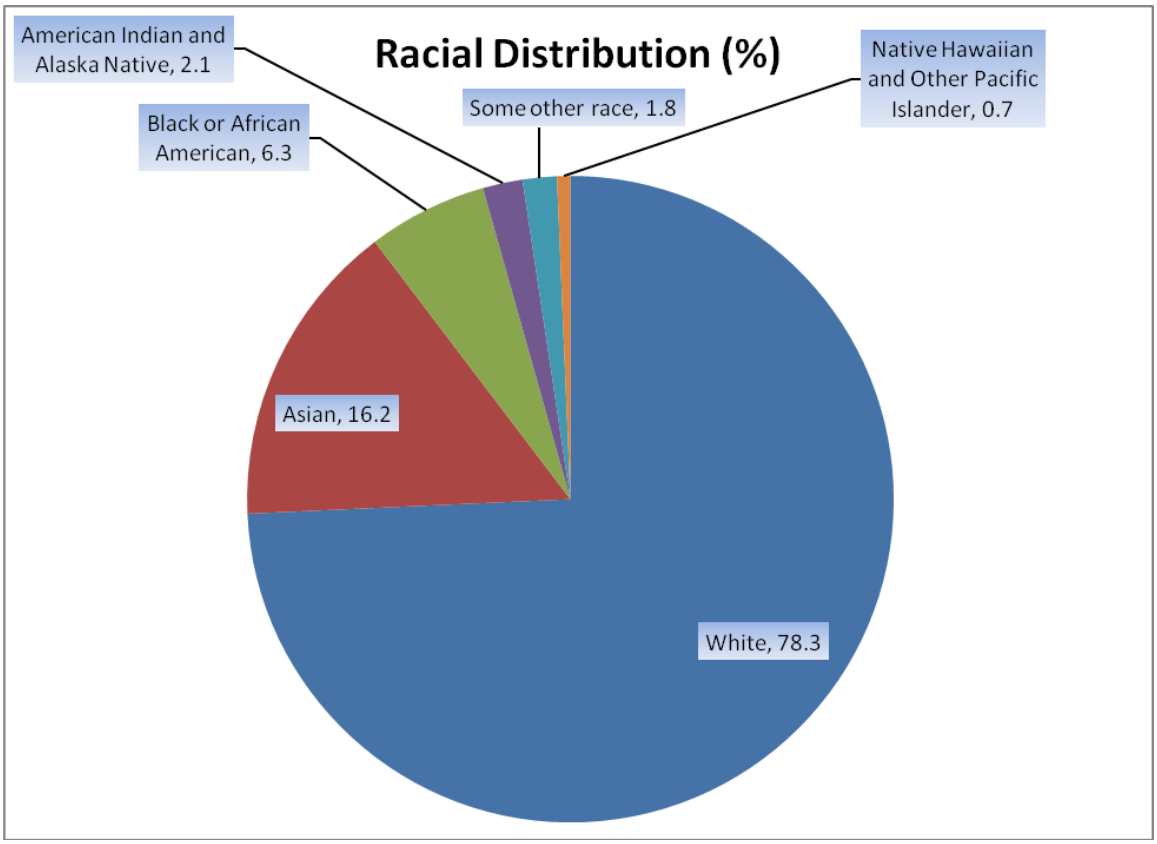


RACE, ETHNICITY AND LANGUAGE

Many researchers have focused on the increased disaster vulnerability that ethnic minorities experience in the United States. As one researcher has pointed out, "History is less likely to count minority victims in death tolls, and to minimize disasters that affect mostly minority victims as 'less disastrous' "(Steinberg 2000). Research shows that minorities are less likely to be involved in pre-disaster planning, experience higher mortality rates during an event and post-disaster recovery can be ineffective and is often characterized by cultural insensitivity. Furthermore, because higher proportions of ethnic minorities live below the poverty line than the majority white population, poverty can compound vulnerability.

Racially, the City of Shoreline appears to be a somewhat homogenous area; about 77% of the population listed "white" on the survey. The largest minority population is Asian, followed by Black or African American. However, these numbers do not reflect the large number of immigrants from Eastern Europe or the Latino population, who may have listed "white only". Figure 2-3 shows race distribution by percent for the city.

Figure 2-3 City of Shoreline Race Distribution



Approximately 9.9% of Shoreline's residents reported speaking English "less than 'very well' " in the 2005 to 2007 survey. The largest group of languages spoken, other than English, was Asian and Pacific Island languages. Over half of those speaking Asian and Pacific Island languages reported that they speak English less than "very well." Many of these groups may be linguistically isolation although the 2005 to 2007 survey does not provide this information. This will have important implications for emergency managers, who must get crucial information out to all members of the population in emergency events.

DISABLED POPULATIONS

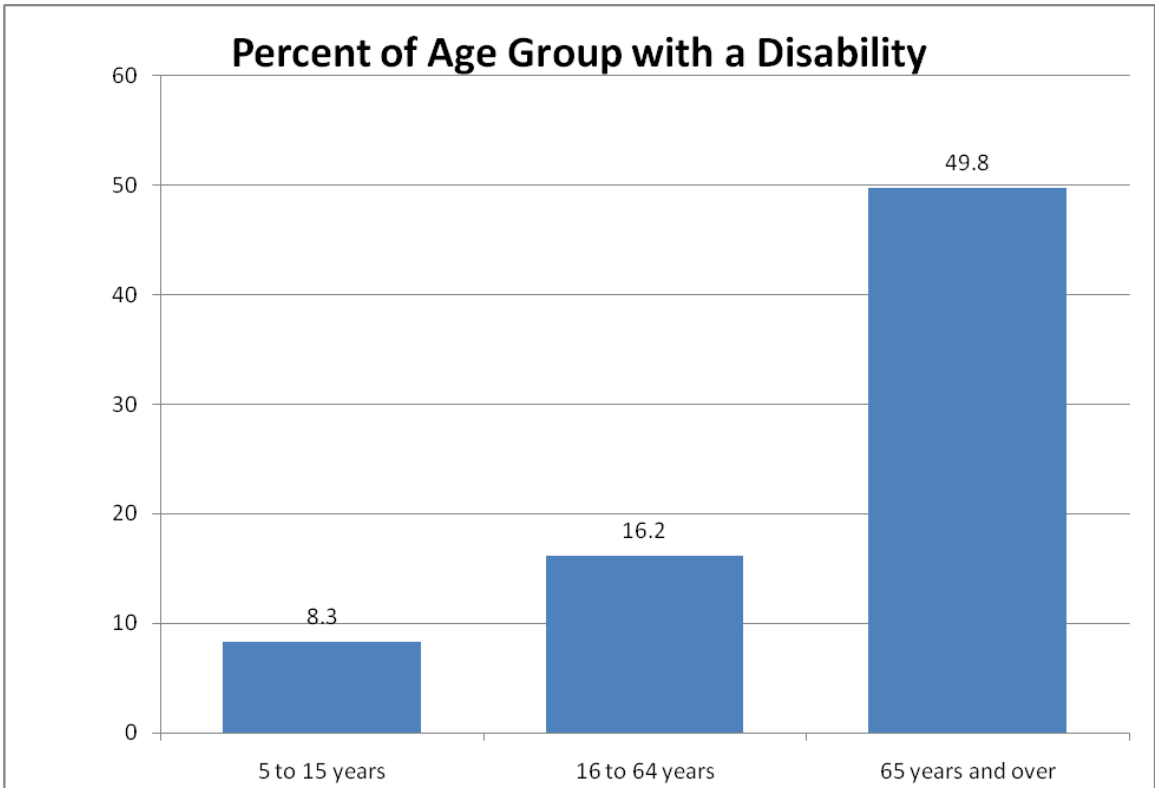
Because people living with disabilities are significantly more likely to have difficulty responding to a hazard event than the general population, they have a special stake in emergency planning efforts. According to U.S. Census figures, 54 million Americans, roughly one-fifth of the U.S. population, live with a disability. These numbers are rising; furthermore, disabled populations are increasingly integrated into society (Bolin 1994). This means that a relatively large segment of the population will require assistance during the 72 hours post disaster event, the period generally reserved for self-help (Tierney et al. 1988).

Disabilities can vary greatly in severity and permanence, making these populations difficult to define and track. There is no "typical" disabled person, which can complicate disaster-planning processes that attempt to incorporate them. Furthermore, disability is likely to be compounded with other

vulnerabilities, such as age, economic disadvantage and ethnicity, all of which mean that housing is more likely to be substandard. In fact, in at least one city, census data indicates that disabled populations are concentrated in older, higher-density housing that is more susceptible to earthquake damage (Tierney et al. 1988).

While the percentage of disabled in Shoreline do not differ much from those of the state as a whole, the overall numbers are significant and warrant special attention from planners and emergency managers. Figure 2-4 shows percent of age group with a disability in Shoreline

Figure 2-4 Percent of Age Group With a Disability



TRENDS

The population of Shoreline is expected to grow by 7 to 12% by 2030. Although, the population is predominately white (78% of the total population), this percentage has dropped over the past decade with foreign-born residents increasing 5 % from 1990 to 2000. The population is expected to continue to diversify. Additionally, over the past few decades, the population over 65 years old has increased and is projected to continue to increase. Over the past three decades household size has declined by 76% to 2.5 persons per household. Single family homes make up 74% of the housing units in Shoreline and new housing is being created through infill construction[3].

[3] http://www.shorelinewa.gov/index.aspx?page=174

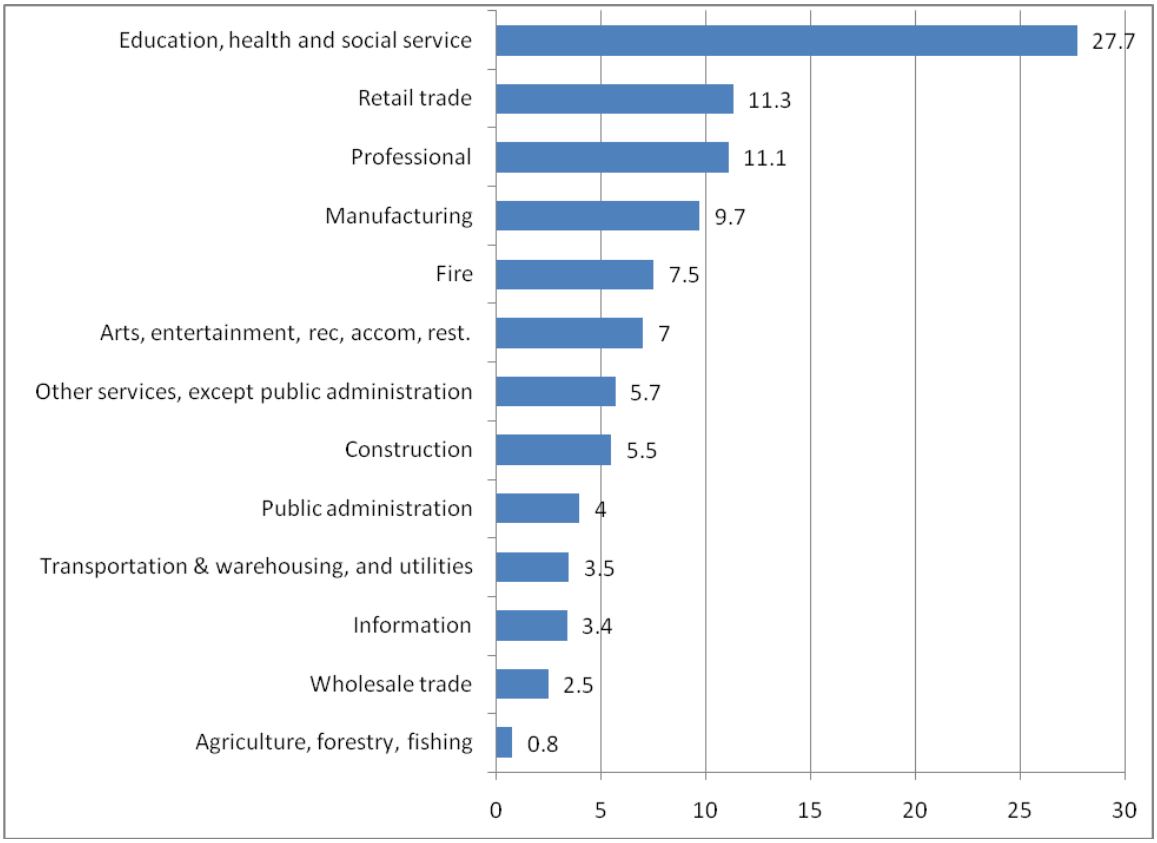
Development patterns in the City of Shoreline were influenced by Seattle becoming King County's commercial center. The City of Shoreline is a developed city with little vacant land. Much of the vacant land cannot be developed do to environmental restrictions, such as steep slopes. The majority of new development in Shoreline is infill development and redevelopment projects.

ECONOMICS

INDUSTRY

The largest industry in Shoreline, at 27.7%, is educational, health and social services. Professional, scientific, management, administrative, and waste management services homes in second at 12.3% and retail trade comes in third at 11.6% (U.S. Census Bureau 2007) (see Figure 2-5).

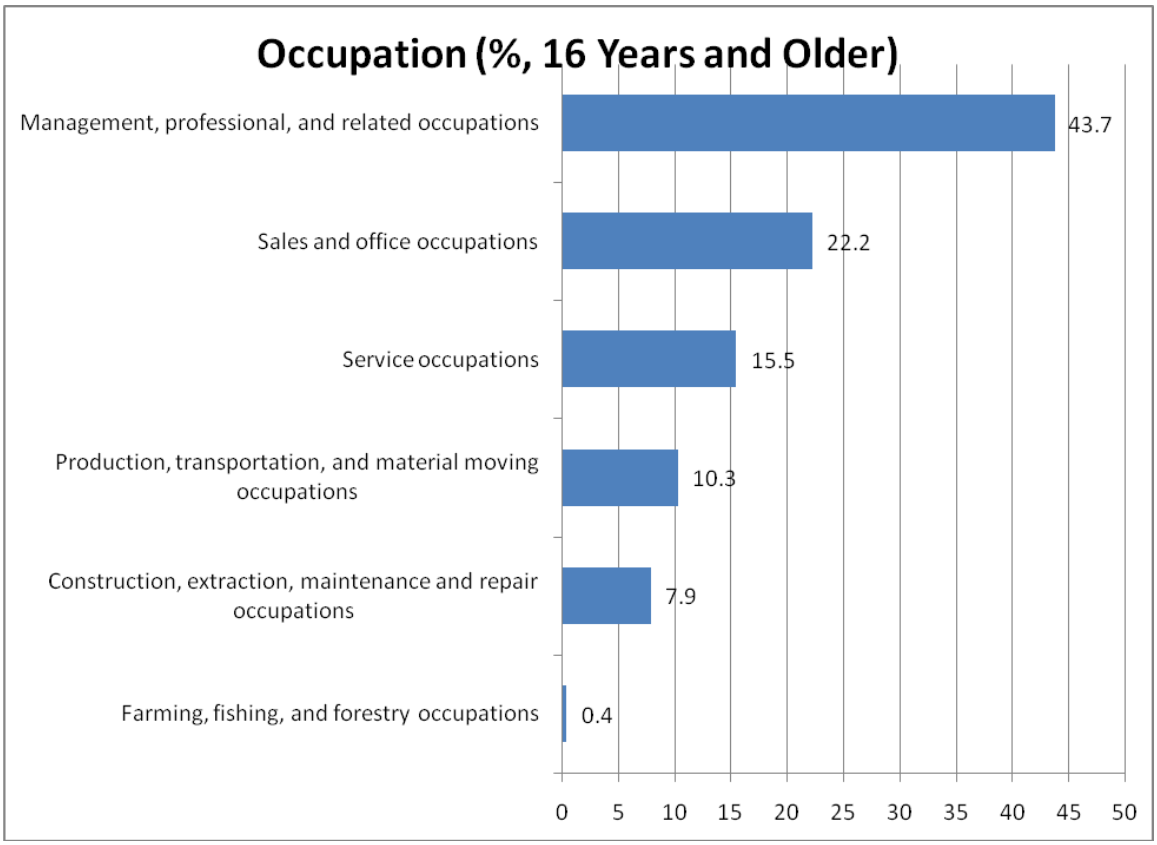
Figure 2-5 Industry in Shoreline



OCCUPATION

In Shoreline, the top three occupations are management, professional, and related occupations (43.7%), sales and office occupations (22.2%), and service occupations (15.5%) (US Census Bureau 2007). Figure 2-6 displays the different occupations in Shoreline.

Figure 2-6 Occupation in Shoreline



LAWS AND ORDINANCES INFLUENCING THIS PLAN

DISASTER MITIGATION ACT (DMA 2000)

The DMA 2000 is the latest legislation to improve the hazard mitigation planning process. It reinforces the importance of mitigation planning and emphasizes planning for disasters before they occur. It specifically addresses planning at the local level, requiring plans to be in place before Hazard Mitigation Grant Program (HMGP) funds are available to communities. This plan is designed to meet the requirements of DMA 2000, improving the City of Shoreline's eligibility for future mitigation funds.

ENDANGERED SPECIES ACT (ESA)

ESA was enacted in 1973 with the purpose of conserving those species that are facing depletion or extinction and the ecosystems that support them. The Act sets forth a process for determining which species are threatened and endangered, and requires the conservation of the critical habitat in which those species live. It is important in hazard mitigation planning to consider habitat and species listed under the ESA.

GROWTH MANAGEMENT ACT (GMA)

In 1990, the Washington State Legislature adopted the Growth Management Act (Chapter 36.70A Revised Code of Washington (RCW)). The Growth Management Act (GMA) mandates that local jurisdictions adopt a comprehensive plan and ordinances that classify, designate, and regulate land use in order to protect critical areas. According to the code, "critical areas" include the following areas and ecosystems: (a) wetlands; (b) areas with a critical recharging effect on aquifers used for potable water; (c) fish and wildlife habitat conservation areas; (d) frequently flooded areas; and (e) geologically hazardous areas (RCW 36.70A.030). In relation to this plan, Shoreline's critical areas include wetland areas and potential landslide areas. The state GMA regulates development in these areas and, therefore, has the potential to affect hazard vulnerability and exposure at the local level.

Shoreline comprehensive plan, and supporting documents including the critical areas ordinance, International Building Code, stormwater management plan, Low Impact Manual and City visioning , project were particularly significant in the development of this update.

SHORELINE MANAGEMENT ACT (SMA)

The Shoreline Management Act (RCW 90.58) was enacted in 1971, and is intended to manage and protect the shorelines of the state by regulating development in the shoreline area. A major goal of the act is "to prevent the inherent harm in an uncoordinated and piecemeal development of the state's shorelines." Its jurisdiction includes the Pacific Ocean shoreline and the shorelines of Puget Sound, the Strait of Juan de Fuca, plus rivers, streams and lakes above a certain size. It also regulates "wetlands" associated with these shorelines.

CITY OF SHORELINE MUNICIPAL CODE

Shoreline's municipal code regulates all development throughout the city and includes code specifically dealing with many hazards.

Table 2-1 shows the summary of Shoreline's capabilities by hazard type.

- Geologic hazards are regulated in Shoreline municipal code 20.80 as a "critical area," as required by the Washington State Growth Management Act.
- Fire protection code is described in chapter 15.10
- The Building and Construction Ordinance (Title 15) is particularly important to this plan as it includes all seismic and safety requirements for homes and businesses.
- The Land Use and Development Ordinance (Title 16) and the Zoning Ordinance (Title 18).

Table 2-1 Department Capabilities Summary by Hazard

Shoreline Departmental Capabilities Summary / Hazard			
Hazard	**Planning**	**Codes and Ordinances**	**Comments**

Earthquake	Shoreline Capital Improvement Plan includes a plan for the replacement of the Richmond Beach Overcrossing that is the access to Apple tree Lane.	Shoreline has adopted and is enforcing the Seismic provision of the International Building code. The Washington State Department of Natural Resources has updated and improved the NEHRP soils map for the state.	Shoreline has adopted the Project Impact Home Retrofitting Program.
Hazardous Materials	Shoreline is a member of the King County Local Emergency Planning Committee (LEPC). The LEPC has developed and is implementing the local emergency plan.	Shoreline has a Hazardous Materials Management Plan under the Shoreline Municipal Code . The Shoreline Comprehensive Emergency Management Plan requires that the Incident Command System be used in responses to hazardous materials incidents.	There are public, and corporate hazardous materials response teams in King County and nearby Snohomish County that are available to the City of Shoreline. http://www.kingcounty.gov/safety/prepare.aspx
Severe Storms and Climate Change	Snow routes are designated to be cleared first and assure navigable routes throughout the city. The City has a Hazardous Weather Plan and has been recognized by the National Weather Service as a Storm Ready Community. The City has adopted the Department of Ecology Low Impact Manual that should reduce runoff and associated surface water flooding.	The International Building Code addresses snow loading and other environmental design concerns. the city is mandated to address steep	Fircrest, CRISTA Ministries, Department of Health Lab, Point Wells, Ronald Wastewater District, Spartan Recreation Center (City's Shelter) and the Police Department all have backup generators. The County has pre-located in the City of Shoreline a large portable generator that it keeps and maintains that can power the Senior Center which is designated as the City's Mass Feeding Shelter.

Landslides and Sinkholes	Steep slopes are addressed through The Growth Management Act.	Landslide hazards are dealt with the Shoreline Municipal Code Critical Areas ordinance.	Burlington Northern/Santa Fe are responsible for landslides along the coast. The BN inspects its tracks frequently and has track and landslide sensors to prevent derailment. The Holiday Blast Storm of December and January 1996-1997 caused a large washout/landslide within Shoreline along NW 175th Street. The sinkhole provided opportunities to implement a series of Low Impact Development concepts ultimately reducing flooding and water quality problems while increasing fish habitat and providing recreation opportunities (see Figure 4 10). The effort was developed as an element of the City Comprehensive Surface Water Master Plan and was completed in 2009.
Flooding	The Shoreline Capital Improvement Plan includes projects to reduce surface water flooding and that associated with Ronald Bog. The Ronald Bog project has improved surface drainage thereby reducing flooding associated with Ronald Bog and the community directly south of the Bog.	The City is participating in good standing in the National Flood Insurance Program and has a designated Floodplain. The City as also adopted the DOE Low Impact Development manual.	Shoreline is vulnerable to surface water flooding, and although the City has a designated flood hazards area, no flooding is associated with areas associated with this Flood Insurance Rate Map. Surface water flooding is associated with many depressions. There are no repetitive loss structures within the City of Shoreline. The old City Hall has flooded and received FEMA Public Assistance Flooding, however the construction of the new City Hall has eliminated this vulnerability.
Wildland Fire	In the Shoreline Visioning project, Comprehensive Capital Improvement Plan supports an improved Interurban Trail. The Trail system would increase access and evaluation opportunities during Wildland Fires as well as Severe Storms and Earthquakes.	Shoreline Municipal Code and the Fire Code address issues relating to Wildland Fire. Actions detrimental to the public health, safety and environment are declared public nuisances and can be restricted including nuisance vegetation.	Wildland fires are most frequent along the coast fueled by low brush. Forested areas exist throughout the community and tree trimming along power corridors is practiced. Tree removal is a volatile topic and is not pursued as a general policy.

Volcano	Currently nothing in place	The International Building Code includes snow load requirements that relate to ash loads.	Since all Northwest volcanoes are in a regular seismic zone, tremors are monitored by the USGS and the University of Washington Seismology Lab.
Tsunamis	Currently nothing in place	Specific codes are not in place that address Tsunamis	Washington DNR is in the process of preparing Tsunami inundation Maps. Outside of a few specific areas noted in this plan the Burlington Northern rail road provide a buffer between Puget Sound and the Coast.

CHAPTER 3 PLANNING PROCESS

The 2009 public process was built upon quarterly and post event Emergency Management Council (EMC) 2004 plan maintenance activities. This continuation of a seamless public planning process was crucial to the development of this Plan update.

Continued involvement of the EMC and by involving the public in the planning process, the public are able to better understand hazards and the importance of hazard mitigation planning. With a comprehensive and transparent public process the City of Shoreline HMP can better reflect the public's concerns and opinions. The public had opportunity for commenting on plan development during several different phases and by way of many public meetings. The planning process involved analyzing city data and plans, and presenting this information at city department meetings, public meetings and meetings with key stakeholders. Additionally, a community survey was hosted on the City website.

PLANNING TEAM FORMATION

The 2009 planning team was comprised of the project planning team and the technical stakeholder committee. These groups were working under the direction of the City of Shoreline Emergency Management Coordinator for the development of the HMP.

The project planning team included the City of Shoreline Emergency Management Coordinator and Risk Reduction Solutions, Inc. This team was responsible for development of all parts of the HMP including re-searching all hazards, writing the HMP and coordinating and documenting the planning process. The technical stakeholder committee was the City of Shoreline Emergency Management Council who has expertise in a variety of fields working in both the public and private sectors. The council was responsible for assisting the project planning team in development and review of the HMP including review of the risk assessment, development of goals, objectives, mitigation strategies, implementation measures and a method for monitoring, evaluating and updating the plan. The council consists of the following (Ord. 328 § 1, 2003; Ord. 103 § 4, 1996):

- The City Manager, or designee, who shall act as chair;
- The Emergency Management Coordinator as appointed by the city manager;

Planning Process FEMA Requirements

Requirement § 201.6(b): In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include:
(1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;
(2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process; and
(3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.

Requirement § 201.6(c): The plan shall include the following:
(1) Documentation of the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.

- The city Public Works Director;
- The city Police Chief;
- A representative of the Shoreline Fire Department, or successor;
- A representative of the Shoreline School District, or successor;
- A representative of the Shoreline Community College, or successor;
- A representative of the Shoreline Water District, or successor;
- A representative of the Ronald Wastewater Management District, or successor;
- A representative of the Shoreline Auxiliary Communications Service, or successor;
- And such city officials and other citizens with technical capabilities in related areas, upon appointment by the City Manager.

The Emergency Management Council for both 2004 and 2009 was comprised of group of representatives from City and jurisdictional organizations with expertise in fields ranging from public utilities to geology to emergency management. While each member was invited to participate in each meeting, attendance was variable. Those who were unable to attend were often contacted by telephone and or met with at their offices for input. Some agencies who participated in 2004 chose not to participate in 2009; while additional agencies were added in 2009.

Table 3-1 shows the agencies and representative who participated in this update.

Table 3-1 Emergency Management Council

Name	Agency Represented	Agency/Dept Participated in 2009
Bob Phelps,	Shoreline Amateur Radio	Yes
Dana Wheelock	Seattle City Light	Yes
Mark Wesolowski	Puget Sound Energy	No *
Mike Wilkinson	NRC: Foss Environmental	No *
Mike Harrison	Seattle City Light	Yes
Al Nelson	Burlington Northern Santa Fe Railway: Police	No
LaDonna Smith	City of Shoreline	Yes
Kelly Melton	Department of Social and Health Services: Fircrest	Yes
Dick Deal	Shoreline Parks Department	Yes
Lisa Dustin	Shoreline Parks Department	Yes
Tom Lentz	Washington State Department of Transportation	Yes
Bridget Smith	City of Shoreline	Yes
Scott Keeny	Shoreline Fire Department Commissioner	Yes
Mark Maynard	Crista Ministries	Yes
Bud Taylor	Washington State Department of Health: Public Health Laboratories	Yes
Brian Wuellnor	Chevron	Fac. Closed
Randy Stegmeier	Shoreline Community College	Yes
Steve LaCruix	Washington State Department of Health: Public Health Laboratories	Yes
Paul Haines	City of Shoreline: Public Works Department	Yes
Paul Plumis	Shoreline School District	Yes
Bob Olander	City of Shoreline: City Managers Office	Yes
R. D'Alessandro	Shoreline Water District	Yes
Marcus Kragness	Shoreline Fire Department	Yes
Ron Mehlert	Shoreline Fire Department	Yes
Debbie Tarry	City of Shoreline	Yes
Clement Rusk	Shoreline Police Department	Yes
Tim Dahl	Shoreline Fire Department	Yes
Leona Obstler	Shoreline Police Department	Yes
Tim Stewart	City of Shoreline: Planning and Development Services	Yes
Joyce Nichols	City of Shoreline: Communications and Intergovernmental Relations	Yes
Jay Clark	City of Shoreline: GIS	Yes

Michelle Bennett	Shoreline Police Department	Yes
Denise Turner	Shoreline Police Department	Yes
Michael Derrick	Ronald Wastewater District	Yes
Bob Crozier	City of Shoreline	
Julie Modrzejewski	City of Shoreline	
Kirk Peterson	City of Shoreline	
*** No –Couldn't make meetings**		

2009 Council Members:

Name	Agency Represented	Agency/Dept Participated in 2004
Bob Phelps	Shoreline Amateur Radio	Yes
Roger Serra	Seattle City Light	Yes
Mark Wesolowski	Puget Sound Energy	Yes
Beratta Gomillion	Center for Human Services	No *
Jerry Koenig	Seattle City Light	Yes
Brian Landau	City of Shoreline Public Works	Yes
Gail Marsh	City of Shoreline Emergency Management	Yes
Leonard Niemczyk	Department of Social and Health Services: Fircrest	Yes
Dick Deal	Shoreline Parks Department	Yes
Lyn Cheney	Shoreline Parks Department	Yes
Morgan Balogh	Washington State Department of Transportation	Yes
Scott Keeny	Shoreline Fire Department Commissioner	Yes
Mark Maynard	Crista Ministries	Yes
Sheri Ashleman	Council of Neighborhood Representative	No *
Ned Worcester	Seattle Public Utilities	No *
Robin Heslop	Shoreline Community College	Yes
Steve LaCruix	Washington State Department of Health: Public Health Laboratories	Yes
Mark Relph	City of Shoreline: Public Works Department	Yes
Don Dalziel	Shoreline School District	Yes
Eric Bratton	City of Shoreline: City Managers Office	Yes
Stuart Turner	Shoreline Water District	Yes
Marcus Kragness	Shoreline Fire Department	Yes
Ron Zsigmondovics	Shoreline Fire Department	Yes
Debbie Tarry	City of Shoreline Finance	Yes
Donna Eggen	Shoreline Chamber of Commerce	No *
Tim Dahl	Shoreline Fire Department	Yes
Heather Volpe	Shoreline Police Department	Yes
Joe Tovar	City of Shoreline: Planning and Development	Yes

	Services	
Susan Will	City of Shoreline: Communications and Intergovernmental Relations	Yes
Jay Clark	City of Shoreline: GIS	Yes
Dan Pingrey	Shoreline Police Department	Yes
Ted Stensland	Shoreline Police Department	Yes
George Dicks	Ronald Wastewater District	Yes
Bob Crozier	City of Shoreline – Customer Service	Yes
Julie Underwood	City of Shoreline City Manager's Office	Yes
Kirk Peterson	City of Shoreline Parks Dept.	Yes
Jesus Sanchez	City of Shoreline Public Works	No
Rob Beem	City of Shoreline Community Services Division	No
Craig Degginger	Shoreline School District	Yes
Mike O'Day	Seattle American Red Cross	No *
Ray Allshouse	City of Shoreline Building Official	No *
Rachel Markle	City of Shoreline Planning and Development Services	Yes
Melanie Granfors	Shoreline Fire Dept PIO	No *
Mark Mayuga	City of Shoreline Economic Development Manager	No *
Michael Rogers	Faith Based Organizations Representative	No *
Nora Smith	City of Shoreline Office of Neighborhood	No *
Peggy Williams Scott	City of Shoreline AmeriCorps VISTA member	No *
Warren Sanders	King County Metro Facilities Manager	No *
No – new in 2009		

* No –Couldn't make meetings

PUBLIC INVOLVEMENT

Public involvement is critical to the success of any strategic planning process; it is particularly important for hazard mitigation plans to consider public concerns, comments, and perception of risk as factors in the creation of mitigation strategies.

PUBLIC COMMENT

The Shoreline HMP update is available on the City of Shoreline's web page, and at City Hall. Several meetings were held to get public comment. The planning project team presented the Shoreline Draft HMP at a City of Shoreline City Council Meeting (See Appendix A for an agenda). After the presentation, the planning project team listened to public comment and concern and answered questions about the plan. At the meeting the project team handed out a worksheet that allowed the public to rank the risk by hazard. The worksheet also allowed for comments and questions and suggestions for mitigation measures for the risks and hazards in Shoreline (See Appendix A for the worksheet).

Table 3-2 lists meeting dates, attendance, purpose of meetings with Department personnel and whether or not these meetings were open to the public. Agenda and lists of attendees are included in the appendix.

Table 3-2 Meeting Dates and Purposes

Date	Attendance	Purpose	Public Notification
20-Oct-08	City staff leadership	Refine Work program / Identify Issues	No
1-/27/08	City Community Services Division Staff	Refine Public process / identify issues.	No
4-Nov-08	Planning Department Staff	Discuss Shoreline Comprehensive Plan and Visioning initiative within in contexts of risks	No
6-Nov-08	Public Works Department Staff	Discuss Public Works plans, indentify issues and risks	No
12-Nov-08	Parks Department	Discuss Shoreline parks plan and projects within context of risks	No
12-Nov-08	EMC	Review 2004 Action Items, Collect data, determine issues	Yes
21-Nov-08	Fire Department Staff	Review 2004 Action Items, Collect data, determine issues	No
1-Dec-08	Fire Department Staff	Explain process and collect data	No
20-Jan-08	Council of Neighborhoods	Explain process and collect data	yes
1-Dec-08	Fire Department Staff	Review call response data	No
5-Dec-08	Fire Department Staff	Explain process and solicit input	Yes
20-Feb-09	Fire Commissioners	Explanation of process and solicit input	Yes
3-Mar-09	EMC	Review risks and discuss action items	Yes
1-Apr-09	Fire & Public Works Department	Review risks and discuss action items	No
10-Jun-09	Community Volunteers	Review and rank mitigation action items	Yes
12-Jun-09	EMC	Review and rank mitigation action items	Yes

PUBLIC NOTICE

An announcement was listed in the Enterprise Newspaper that stated that the City of Shoreline was seeking public comment on the plan, where copies of the plan were available for review and where questions and comments could be received (See Appendix A). The announcement also stated that the plan would be presented at an upcoming EMC meeting and welcomed public comment at that meeting.

The Enterprise is a local newspaper that serves the South Snohomish County and North King County market.

COMMUNITY SURVEY

The Planning team thought it important to take advantage of tools that were unavailable when preparing the 2004 plan. Accordingly, a survey of residents risk reduction and mitigation concerns was placed on the City website and was open to all residents. This survey provided opportunity for residents to share their opinions and participate in the mitigation planning process. The information provided by respondents helped the city better understand resident's hazard concerns and identify areas, policies and projects that can help lessen the impact of future hazard events. The survey was announced on the City of Shoreline home page and within the "Currents" community newspaper. Announcements were also made at community meetings, and sent to individuals and community organizations based on City distribution lists. The survey ran for two months between December and February of 2008; 219 people responded to the survey.

The results suggested several strengths for the City of Shoreline. Generally, respondents placed great faith and trust in both the Shoreline Fire and Police Departments and the Emergency Manager. Additionally, there was also great trust in the neighborhood organizations. Lastly, many individuals have taken basic risk reduction measures such as, knowing how to turn off power, had a first aid kit available or had an out of area contact. The survey announcements and results are provided in Appendix A. Below are listed a few of the main questions from the survey (See Figure 3-1 to Figure 3-5).

Figure 3-1 "How concerned are you about the possibility of Shoreline being impacted by a disaster?"

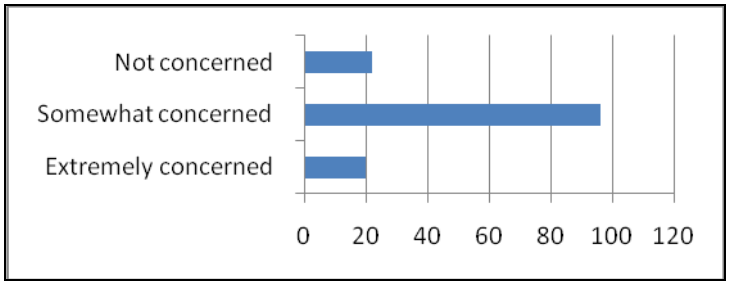


Figure 3-2 "What hazards do you think are the highest threat to your neighborhood?"

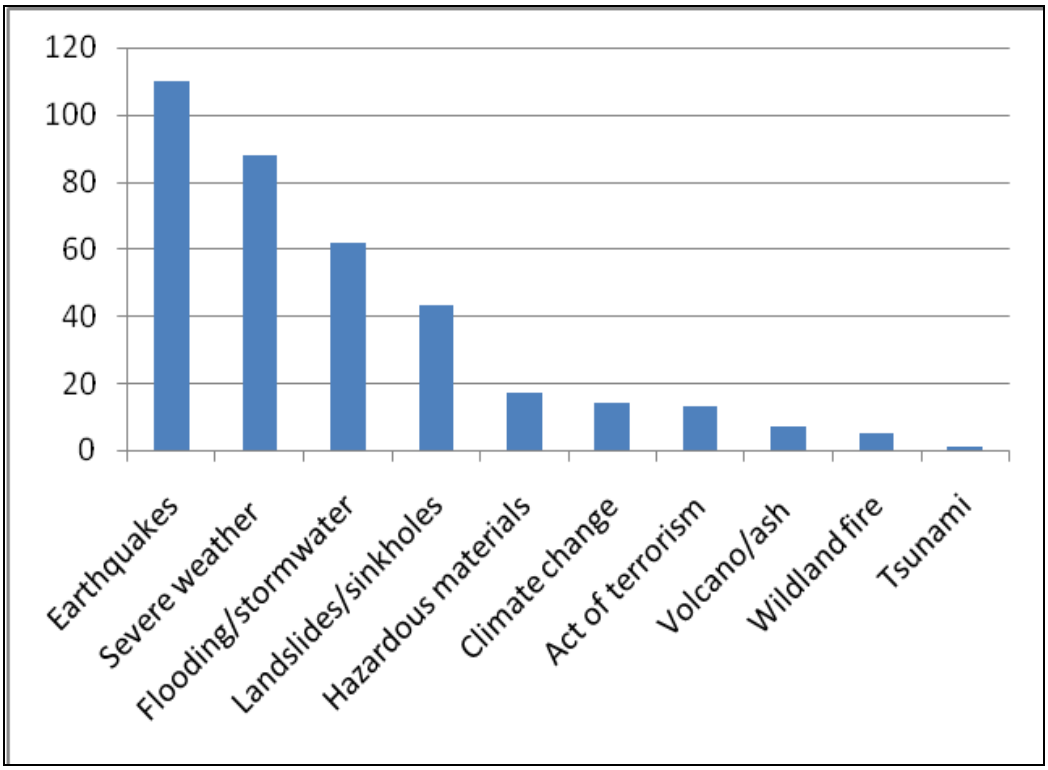


Figure 3-3 Have you taken any actions to make your family, home, business or neighborhood more resilient to risks associated with these hazards or prepared to respond to them?

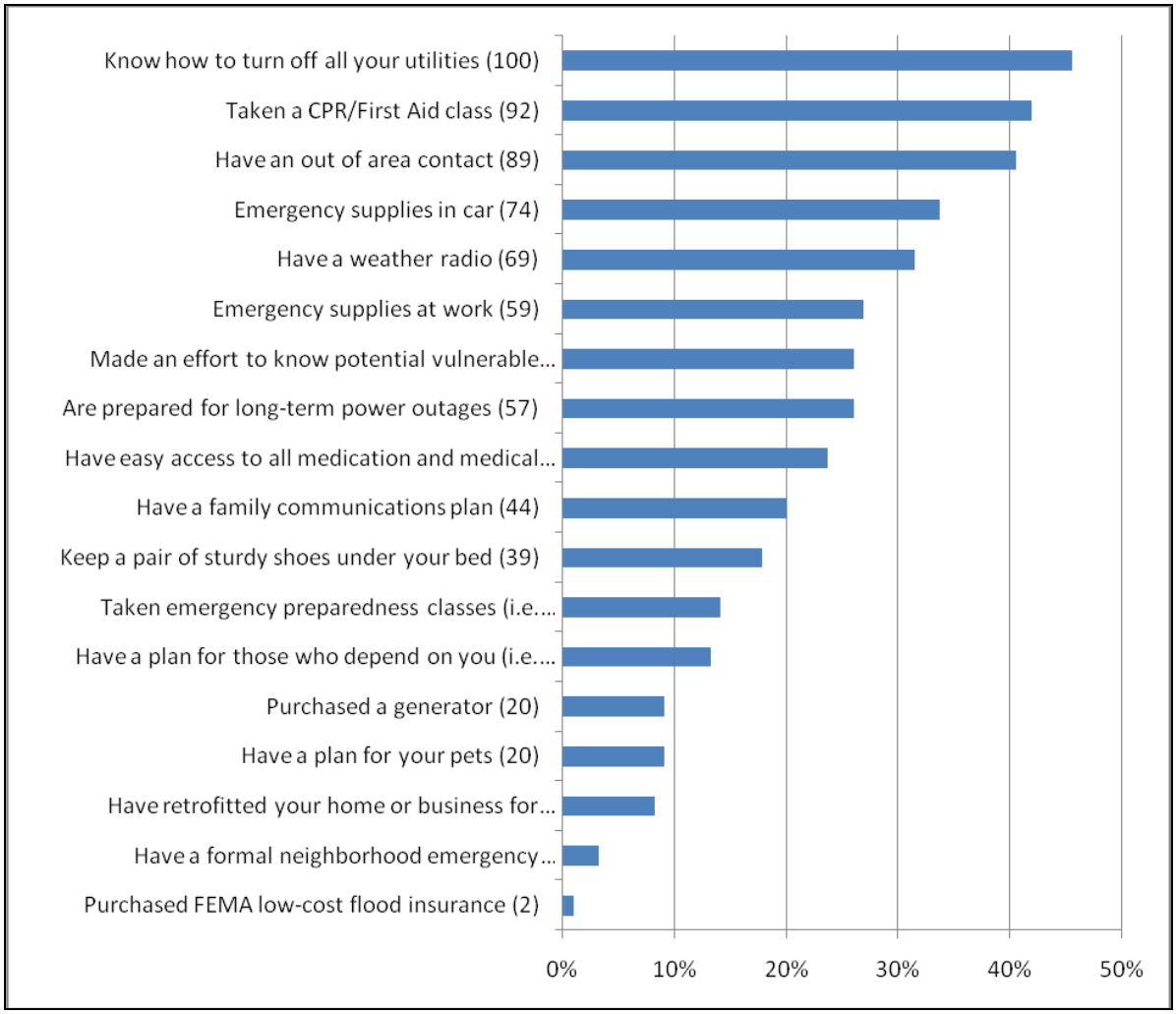


Figure 3-4 "When thinking of risks associated with these threats what do you feel are Shoreline's greatest strengths?"

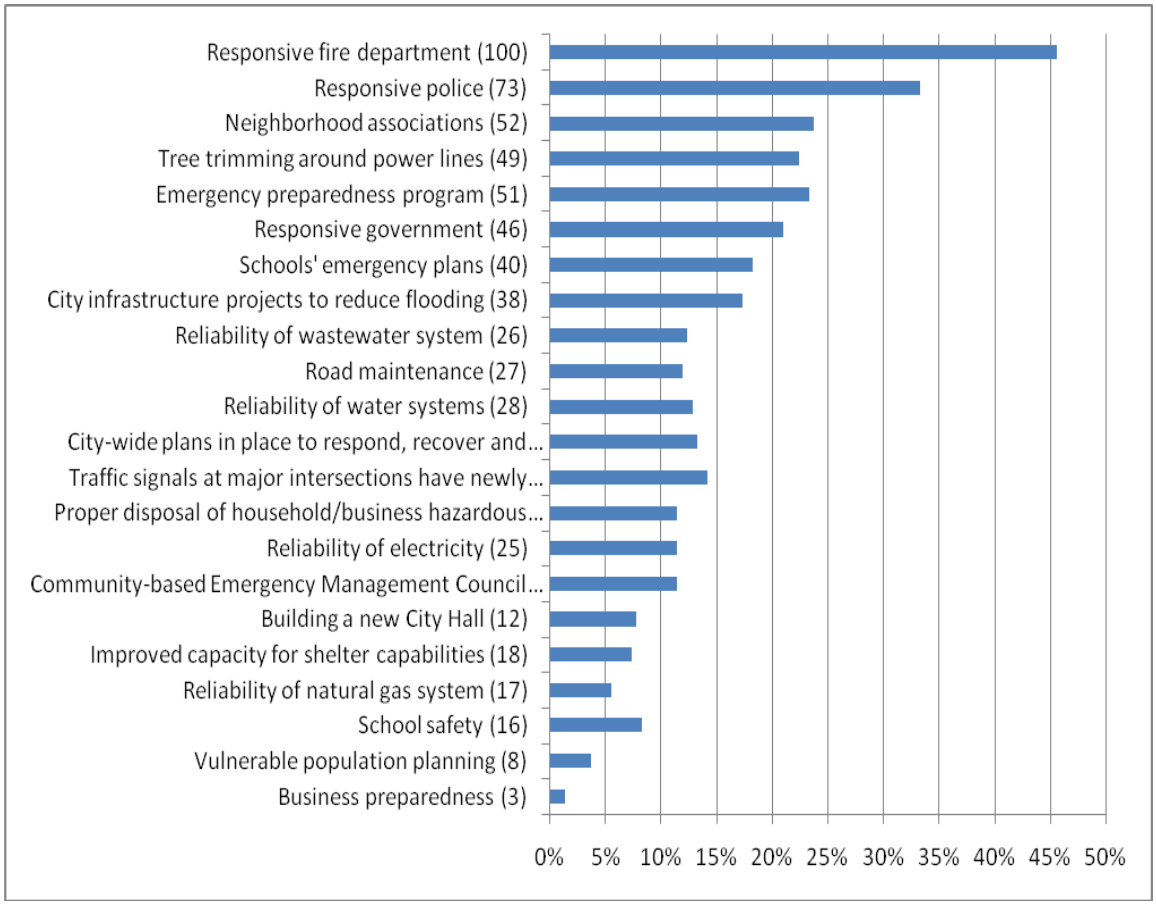
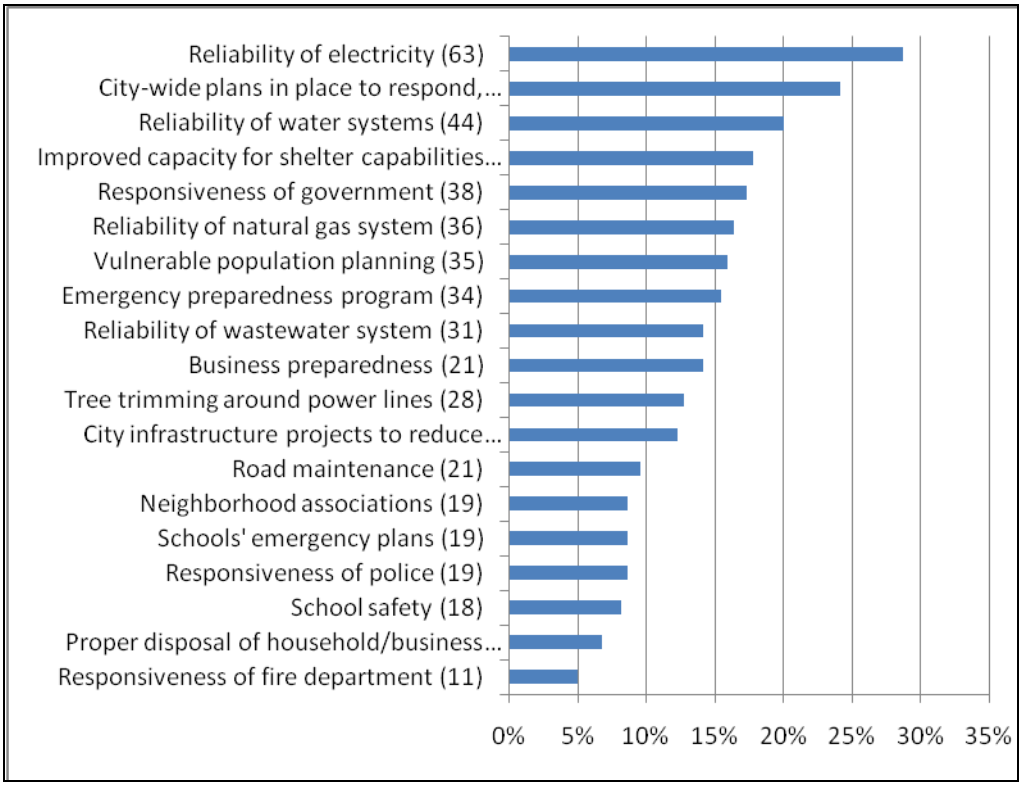


Figure 3-5 "When thinking of risks associated with these threats what do you feel are Shoreline's challenges and opportunities to improve?"



CHAPTER 4 RISK ASSESSEMENT

BACKGROUND

This updated risk assessment relies heavily on that included within the earlier plan. However, where better hazards or vulnerability information was available, it was used, and scenarios were re-written to reflect new data. HAZUS risk models were run using more current hazards information. This update recognizes Climate Change as a growing hazard. Climate change and global warming was not included within the 2004 HMP. The Shoreline Emergency Management Council agreed to include climate change as an element of the severe weather hazard discussion at their November 12th 2008 meeting.

This section will describe the risks facing the City of Shoreline from each of eight hazards designated as significant. This section will also elaborate upon the hazard definition, vulnerabilities and probable event scenarios. Taken as a whole, this section assesses the risk that Shoreline is likely to experience from hazard events. The following process was used to define risk of each hazard, which is reflected in the organization of the section:

- Identify and profile each hazard
- Determine manmade and environmental systems exposed to each hazard
- Assess the vulnerability of exposed infrastructure and facilities
- Identify probability of occurrence and impact.

Risk Assessment Requirement

Requirement § 201.6 (C.2): A *risk assessment* that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards. The risk assessment shall include:

(i) A description of the type, location, and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.
(ii) A description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community. All plans approved after October 1, 2008 must also address NFIP insured structures that have been repetitively damaged by floods. The plan should describe vulnerability in terms of:

(A) The types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas;
(B) An estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(i)(A) of this section and a description of the methodology used to prepare the estimate;
(C) Providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

METHODOLOGY

ASSESS HAZARDS

This assessment includes the following information for each hazard:

- Geographic areas most affected by hazard
- Event frequency estimates

- Severity
- Warning time likely to be available for response

DETERMINE EXPOSURE AND ASSESS VULNERABILITY

Exposure was determined by overlaying hazards with an inventory of potentially vulnerable structures, facilities and systems to determine which of them would be exposed to each hazard. The City of Shoreline's GIS database contains extensive coverage of infrastructure, including homes, industry, roads, bridges, and water mains. Vulnerability of the exposed structures and infrastructure were then assessed. Vulnerability was determined by interpreting the combination of probability of hazards in the area occurring with the amount and value of the items exposed.

DETERMINE RISK

Risk was determined by first describing a most probable case hazard scenario or impact that might affect the city. Using this scenario, the team estimated future expected losses from hazard events.

DATA SOURCES

A variety of data sources was used. Frequency and severity indicators include past events and the expert opinions of geologists, emergency management specialists and others. To the extent possible, the hazard location was mapped using GIS. The primary data source was the City of Shoreline, which is quite extensive, though other sources were also employed and are mentioned in each respective section.

PRESIDENTIAL DECLARED DISASTERS

Presidential Declared Disasters are typically events that cause more damage than state and local governments/resources can handle without the assistance of the federal government. There is not generally a specific dollar loss threshold that must be met. A Presidential Major Disaster Declaration puts into motion long-term federal recovery programs, some of which are matched by state programs, and designed to help disaster victims, businesses and public entities[4]. Table 4-1 shows Presidential Declared Disasters in King County. Those that are bolded had a direct impact on Shoreline.

Table 4-1 - Presidential Declared Disasters in King County

Declaration No.	Type of Disaster	Date of Disaster
185	Flood	December - 64
196	Earthquake	May - 65
328	Flood	February-72
492	Flood	December-75

[4] *FEMA, http://www.fema.gov/library/dproc.shtm*

545	Flood, Landslide	December-77
612	Flood	December-79
623	Volcano	May-80
757	Flood, Landslide	January-86
784	Flood	November-86
852	Flood, Landslide, Wind	January-90
883	Flood	November-90
896	Flood	December-90
981	**Wind**	**January-93**
1079	Flood	November – December-95
1100	Flood	January – February- 96
1159	**Ice, Wind, Snow, Landslide, Flood**	**December-96 to February-97**
1172	Flood, Landslide	March-97
1361	**Earthquake**	**February-01**
1671	**Severe Storm, Flood, Landslide & Mudslide**	**November -06**
1682	**Severe Winter Storm, Wind, Landslide, & Mudslide**	**December-06**
1734	**Severe Storm, Flood, Landslide & Mudslide**	**December-07**
1817	**Severe Winter Storm, Landslide, Mudslide, and Flood**	**January-09**
1829	Severe Winter Storm, Record & Near Record Snow	March-09

CRITICAL FACILITIES, INFRASTRUCTURE AND FUNCTIONS

Critical and essential facilities and infrastructure are those that are critical to the health and welfare of the population. These become especially important after any hazard event occurs. Critical and essential facilities included for the City of Shoreline are as follows: police and fire stations, schools and emergency operations centers. Critical infrastructure includes the roads and bridges that provide ingress and egress and allow emergency vehicles access to those in need and the utilities that provide water, electricity and communication services to the community. Also included are Tier II facilities and the railroad, which holds

or carry significant amounts of hazardous materials with a potential to impact public health and welfare in a hazard event. This section provides the results of an exposure analysis where each critical facility and infrastructure has been evaluated to determine the hazards that are likely to affect it (see **Table 4-2**). In general, the City of Shoreline's critical infrastructure is relatively well located and is exposed to few hazards. Also, the management of key critical infrastructures is outside of the City's control. Water, Power, Commutations, regional transportation are not managed by the City of Shoreline. Police is a Department of the City and the Shoreline Fire Department has been included within this Multi-hazards Jurisdiction Plan update. The following criteria were used to determine exposure:

- Earthquake: In an earthquake, all of the City of Shoreline will experience potentially damaging ground shaking. It has the potential to cause major structural and/or non-structural damage to any non-retrofitted facility and hamper its functionality. Hazards US (HAZUS) software was used to offer generalize loss estimates. Within 2004 HMP, four HAZUS scenarios were run. The 2009 update ran a single HAZUS run reflecting probabilistic ground motions that factored in each of the four scenario earthquakes included within the 2004. Specific exposed risk areas were identified by overlying HAZUS generated Peak Ground Acceleration maps over land cover and soils maps. The facilities located on National Earthquake Hazards Reduction Program (NEHRP) D & E soils and high liquefaction areas would be most likely to sustain damages. This process was similar to that undertaken in the 2004 HMP. However better updated NEHRP was available in 2009

- Severe Weather & Climate Change: Since the entire city is susceptible to severe weather, all critical infrastructure is considered exposed to this hazard. Given that electrical utilities and roads are most often affected by severe weather, all critical infrastructure managers and operators should plan for possible power outages and difficult ingress and egress. Some critical infrastructure, such as power lines, is actually more likely to be impacted or damaged as a result of severe weather.

- Flooding: Although any critical infrastructure within the 100-year floodplain is potentially exposed to flooding the floodplains in Shoreline are restricted to short reaches of small creeks. Flood damage is the result of surface water and not dependent on developed river channels. Structures exposed to riverine flooding were identified. Those that may be exposed to generalized surface water flooding were not be similarly identified.

- Landslide/Sinkholes: Critical facilities are considered exposed to landslides if they are on or below historic landslides or potentially unstable slopes were identified.

- Wildland Fire: Any critical infrastructure near high fuel areas load areas is exposed to risk from wildfires. General areas exposed to areas with higher fuel loads on slopes were identified

- Volcanic Eruption: Though volcanoes are considered in this plan, they are not likely to cause any major damage in Shoreline. However, there is a potential for the city to be affected by ash fall from an eruption at Glacier Peak or Mount Rainier. Critical facilities and infrastructure are considered exposed to volcanoes if they are within the city. However, a more in depth analysis of amount and location of ash fall would need to be completed to more accurately determined exposure. A few utilities and roads might be affected.

- Hazardous Material: There are eight reported Tier II facilities located in Shoreline as well as the Washington Department of Health Lab. Any of these facilities and/or infrastructure that either contain hazardous materials or are in close proximity to facilities that contain hazardous materials are potentially exposed to hazardous materials spills. However, the area of exposure and severity of impact is dependent on the type of chemical involved and the mode of release, such as airborne, spilled into water or spilled onto concrete. Critical facility exposure to hazardous materials would require an extensive and complex process that is beyond the scope of this project. Hazardous material exposure is therefore eliminated from this analysis. In addition, areas adjacent to hazardous material transport routes are more likely to experience exposure. The main local routes for hazardous materials transport are Interstate 5, Aurora Avenue and the railroad located along the west shore of the city. All city government facilities are within close proximity of a transport route and should be considered exposed.
- Tsunami/Seiche: Critical facilities and infrastructure are considered exposed if they are located along the Puget Sound shoreline.

Table 4-2 - Critical Infrastructure/Facilities Affected by Hazard Events

Hazard Event	Critical Facility/Infrastructure
Earthquakes	Seattle Tolt Supply Main Shoreline Police Facility at 1206 N 185th St, Shoreline 3.7 & 2.0 MG Reservoir Communication Tower I-5 Bridges: 145th, 155th, 175th, 185th Richmond Beach Bridge Saltwater Park Pedestrian Bridge Railroad Track Aldercrest Aldercrest Annex
Severe Weather & Climate Change	All critical infrastructure and facilities
Flooding	None (there are no critical infrastructures directly exposed to riverine flooding. Surface water collects in depressions with pour drainage throughout the City.)
Landslide/Sinkhole	None (landslides have impacted the Burlington Northern Railroad (BNRR) but the rail corridor is outside of the City's control)
Wildland Fire	None (Wildland fire has occurred along the beach front impacted the BNRR)

Volcano	None (Volcanic ash has impacted infrastructures, but none within the City's control)
Hazardous Materials	Railroad (Rail accidents have occurred along rail right-of-ways. To date none within the City limits. The City has participated in ESF 10 exercise through t he Shoreline Fire Department and City Emergency Response Plan. Tier II Facilities
Tsunami/Seiche	None (The BNRR would be impacted by Tsunami's)

EARTHQUAKES

DEFINITIONS

Benioff Earthquake: Sometimes called "deep earthquakes," these occur in the Pacific Northwest when the Juan de Fuca plate breaks up underneath the continental plate, approximately 30 miles beneath the earth's surface.

Cascadia: Cascadia is that portion of North America that lies between Cape Mendocino in northwestern California and the southernmost tip of the Queen Charlotte Islands just off Canada's west coast. Cascadia's western boundary lies approximately 50 to 70 miles off the Pacific coast, where two tectonic plates, the North America and Juan de Fuca plates, meet and collide at the breathtaking velocity of 1.5 inches per year. Cascadia's eastern boundary is defined as the crest of the Cascade Range[5].

Shallow or Crustal Earthquakes: Crustal quakes occur at depths of up to 10 miles beneath the earth's surface, can create surface ruptures and are associated with fault movement within a surface plate.

Earthquake: An earthquake is the shaking of the ground caused by an abrupt shift of rock along a fracture in the earth such as a fault or a contact zone between tectonic plates. Earthquakes are measured in both magnitude and intensity.

Intensity: Intensity is a measure of the effects of an earthquake at a specific location. It is typically measured by the Modified Mercalli scale and is expressed in Roman Numerals.

Liquefaction: Liquefaction is the complete failure of soils, occurring when soils lose shear strength and flow horizontally. It is most likely to occur in saturated fine grain sands and silts, which behave like viscous fluids when liquefaction occurs. This situation is extremely hazardous to development on the soils that liquefy, and generally results in extreme property damage and threats to life and safety.

Magnitude (M): Magnitude is the measure of the strength of an earthquake at its origin, and is, typically, measured by the Richter scale. As an estimate of energy, each whole number step in the magnitude scale

[5] http://www.crew.org/about/cascadia.html

corresponds to the release of about 31 times more energy than the amount associated with the preceding whole number value.

> *Difference between Magnitude and Intensity: Using a light bulb to demonstrate magnitude and intensity, a light bulb's magnitude can be expressed in wattage. A 100-watt light bulb is 100 watts whether it is next to you or a mile away. Similarly, an earthquake having a magnitude of 6.7 will have that same magnitude no matter where you are. In contrast, intensity is measure at allocation. A 100-watt light bulb will provide high intensity light to allow you read if it is near you. That same 100-watt light bulb will likely not be visible a mile away. The intensity of the light is very low, although the light bulb is still producing 100 watts of energy. An earthquake producing high energy that registers at M6.7 on the Richter scale, may also register a high intensity of 'X' on the Modified Mercalli scale if near the source. However, if you are several 100 miles away, that same M6.7 earthquake might not even register an 'I' on the MMI scale. Peak Ground Acceleration (PGA) is also a measure of intensity.*

Peak Ground Acceleration: Peak Ground Acceleration (PGA) is an intensity measure of the highest amplitude of ground shaking that accompanies an earthquake, based on a percentage of the force of gravity.

Subduction Zone Earthquake: This type of earthquake occurs along two converging plates, attached to one another along their interface. When the interfaces between these two plates slips, a sudden, dramatic release of energy results and is propagated along the entire fault line.

BACKGROUND

Three source zones produce earthquakes in Cascadia. *Shallow* earthquakes start within the crust of the overlying North America plate. *Deep* earthquakes start below the interface between the subducting Juan de Fuca and Gorda plates and overlying North America plate. The *Cascadia Subduction Zone* is the third zone and is on the interface between the subducting plate and the North America plate. Because of its great extent, it can break over an enormous area, causing chaos across all of Cascadia. Each type exhibits a specific set of characteristics.

The impact of any earthquake event is largely a function of ground shaking, liquefaction and distance from the source of the quake. Liquefaction generally occurs in softer, unconsolidated soils. A program called the National Earthquake Hazard Reduction Program (NEHRP) creates maps based on soil characteristics so that locations potentially subject to liquefaction and strong ground shaking may be identified. Table 4-3 provides a description of the NEHRP soil classification.

Shoreline soil was compacted by glaciers and therefore most of the city is built on relatively firm NEHRP "B" and "C" soils. However, a few locations, where rivers have washed through these consolidated soils or where the sea has eroded these soils, are subject to more intense ground shaking and liquefaction.

Table 4-3 NEHRP Soil Types

NEHRP Soil Type	Description	Mean Shear Velocity to 30 m (m/s)
A	Hard Rock	1500
B	Rock, highly consolidated soil	760-1500

C	Consolidated soil	360-760
D	Intermediate soils	180-360
E	Unconsolidated soft clays, alluvium	<180
F	Special study soils (liquefiable soils, sensitive clays, alluvium/ organic soils, soft clays > 36 m thick)	<180

The degree of ground shaking (or damage) caused by an earthquake at any given site is assigned a numerical value from Roman numeral I to XII based on intensity using the Modified Mercalli Intensity (MMI) Scale. This helps assess and understand the physical effects of the earthquake. Table 4-4 provides a comparison of peak ground acceleration to the MMI scale.

Table 4-4 MMI Scale

PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	*<.17*	*.17-1.4*	*1.4-3.9*	*3.9-9.2*	*9.2-18*	18-34	34-65	65-124	>124
PEAK VEL. (cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	*16-31*	*31-60*	*60-116*	*>116*
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Below is a discussion of the three earthquake hazards; discussing location, severity, timing and frequency, and as to secondary impacts (see Figure 4-1).

SHALLOW EARTHQUAKES

- Location: Shallow earthquakes occur within the continental crust of the overlying North America plate, generally at depths of less than 20 miles (35 kilometers). They are sometimes called crustal earthquakes. Because of the abundance of shallow faults, small earthquakes are recorded every day in Cascadia. The presence of these faults directly under the surface, sometimes in populated areas, means that damaging shallow earthquakes occur every few decades. Of concern to the City of Shoreline are the South Whidbey Island Faults within the City and to the North, and the Seattle Faults to the South.

- Frequency: Any specific fault may produce an earthquake every few hundred years or every few thousand years. Ruptures along the South Whidbey Fault and Seattle Fault would be relatively rare. Seattle and South Whidbey Island type earthquakes occur on average every 1000 years.

- Severity: Shallow earthquakes are expected to be less than M7.5. Ruptures along the South Whidbey Fault would occur.

- Timing: Strong shaking generally lasts a few seconds to a minute or so, although it could be longer in localized areas. Aftershocks are common and may cause further disruption.

- Secondary Hazards: Tsunamis are unlikely, though there could be a local tsunami from landslides, or from shallow earthquakes occurring under Puget Sound, the Strait of Georgia, or large lakes and rivers and could impact the Shoreline coast.

- Past events: Significant recent shallow Cascadia earthquakes include the 1993 Scotts Mills, Oregon (M5.6), two 1993 Klamath Falls, Oregon (M6.0 each), and 1954 Eureka, California (M6.5) events.

DEEP EARTHQUAKES

- Location: Deep earthquakes take place within the oceanic plate as it descends, or subducts, beneath the North America plate. They occur on faults within the subducting Juan de Fuca plate. (Beneath northwestern California, deep earthquakes occur within the Gorda plate.) Beneath Puget Sound, deep earthquakes occur at depths of about 30 to 50 miles (80 to 45 km); beneath northwestern California, the depths are somewhat shallower, on the order of 25 miles (40 km). Because the faults that break during the earthquake are so deep, the seismic wave energy they radiate spreads over a much larger area than in a shallow quake. A larger area experiences significant shaking, although much less so directly above the fault, than in a similar-sized shallow quake.

- Severity: They are usually less than M7.5.

- Frequency: Damaging deep earthquakes occur every 10-30 years in Puget Sound but less frequently elsewhere.

- Timing: Few, if any, aftershocks occur.

- Secondary Impact: No tsunami is expected, although landslides could trigger local tsunamis that could impact the city's coast.

- Past Events: In the past 150 years, most damaging deep earthquakes have been in the Puget Sound area. Recent examples include the 2001 Nisqually (M6.8), the 1965 Seattle (M6.5), and the 1949 Olympia (originally measured M7.1, now revised to M6.8) earthquakes in Washington.

SUBDUCTION EARTHQUAKES

- Location: The Juan de Fuca and Gorda plates (offshore northern California) descend, or subduct, beneath the North America plate. Large areas of the interface between the two plates act as if stuck, causing stresses to build. Eventually the stresses reach the breaking strength and the two plates slip rapidly, releasing the stresses. Huge areas may slip, generating very large earthquakes that radiate strong seismic waves throughout Cascadia.

- Severity: They can be as large as M9.

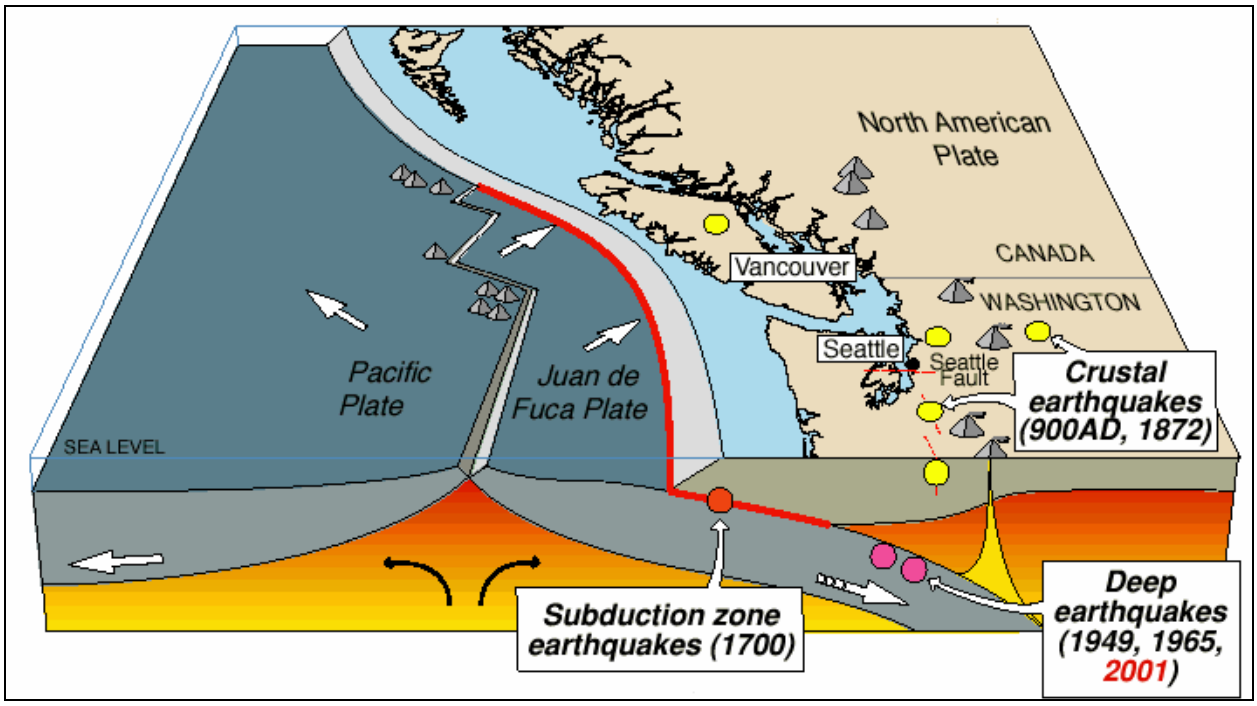
- Frequency: Geological evidence suggests an average of 500 years between events.

- Timing: Depending on location, strong shaking might be felt for several minutes. Injuries and fatalities could number in the thousands, and hundreds of buildings could be destroyed. Many aftershocks will occur; some in the M7 range are possible, creating the potential for additional damage.

- Secondary Impact: A destructive tsunami will quickly hit the Cascadia coast, and travel across the Pacific Ocean toward Alaska, Hawaii, and Asia. A tsunami will travel through the Straights of Juan de Fuca, hit Whidbey Island and migrate into Puget Sound, with affects lasting several hours.

- Past Events: The last Cascadia earthquake occurred on January 26, 1700. Previous quakes were in the years (approximately) 900, 750, and 400.

Figure 4-1 Earthquakes Affecting Shoreline



PROBABILISTIC EVENTS

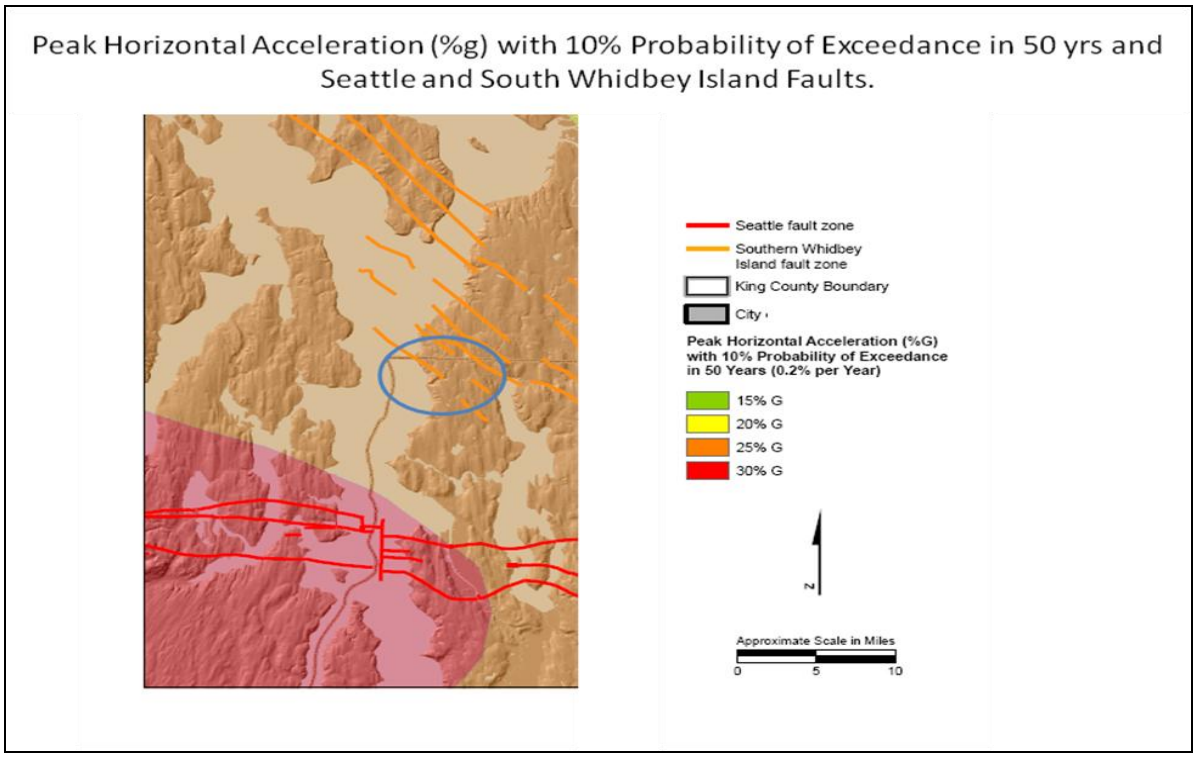
With three possible types of earthquake, what should the residents of Shoreline plan for? There are two basic approaches. One is to plan for each discrete event separately and the other is to consider the most likely event and consider all three types of events and the possibilities of each. The 2004 HMP used four earthquake scenarios to drive the plan reflecting Benioff, South Whidbey, Seattle Fault and Cascadia Subduction Zone events. Fortunately the United States Geological Survey (USGS) has created probabilistic maps offering expected ground shaking estimates considering all three types of earthquakes. These maps illustrate probable PGAs for all earthquakes that have a 10% chance of being exceeded within 50 years. This means that for many of us, within our lifetimes (50 years) there is a 10 percent change that in Shoreline, we will experience ground shaking with a force equal to or greater than 25% of our body weight (or the weight of the building we are in). These projections were made assuming NEHRP "C" soils. Thus, for softer "E" or "D" soils, ground shaking would be greater.

This also means that there is a greater chance of more frequent, less severe earthquakes. As mentioned above, damaging deep earthquakes occur every 10-30 years in Puget Sound. As with the last Deep earthquake, the Nisqually earthquake, Shoreline experienced ground shaking of about 4% PGA to 15 % PGA. The Nisqually earthquake was south of the City and southern areas closer to the earthquake

epicenter experienced greater ground motion than the northern areas that were farther away. The ground shaking was greater on softer soils than harder ones.

Figure 4-2 illustrates this probabilistic projection along with illustrating known shallow faults.

Figure 4-2 Probabilistic Projection[6]



The following discussion focuses on these probabilistic estimates – there being a 10% chance of the City experiencing or exceeding ground shaking of 25% PGA or greater within 50 years. Softer soils will be greater. Hard soils less. The Plan will also look at significant impacts worthy of mention that may be possible from one of the three types of earthquakes.

In this analysis this plan will present the:

- Hazard as a mapping layer illustrating the location of the most probable damaging event,
- Vulnerabilities exposed to this hazards, and a
- Scenario will be offered to place a realistic face on the most probable incident.

HAZARD

[6] http://gldims.cr.usgs.gov/nshmp2008/viewer.htm

Approximately 13,000 years ago, a series of glaciers covered the City with a mile high slab of ice. The huge weight of this ice compacted much of the City leaving a stable platform of consolidated soils on which to build. However, although the consolidated soils help provide a solid foundation for structures, their impermeability increases stormwater problems. The few areas that do not contain consolidated soils are isolated to areas where rivers or the Puget Sound washed away these compacted layers, leaving unconsolidated soft clays and alluvium. These isolated unconsolidated soft clays and alluvium represent the problem areas.

These are shown in the maps below. Figure 4-3 displays NEHRP soils and Figure 4-4 shows liquefaction in Shoreline. This data is developed by Washington State Department of Natural Resources. It is important to note that the soils and ground-shaking are generalized by these maps. The main areas that are being targeted for purposes of this HMP are NEHRP soils E and D. However, it is also important to know that there is still a risk of damage for structures located on C-D, C and B soils. As can be seen by the maps below, areas of special concern from earthquake ground shaking and liquefaction include the following neighborhoods: Richmond Beach, Innis Arden, Ballinger and Ridgecrest. The data shows that these neighborhoods have areas have NEHRP D, E and F soils and are classified as being at moderate to high or high risk from liquefaction.

Figure 4-3 Shoreline NEHPR Soils Map

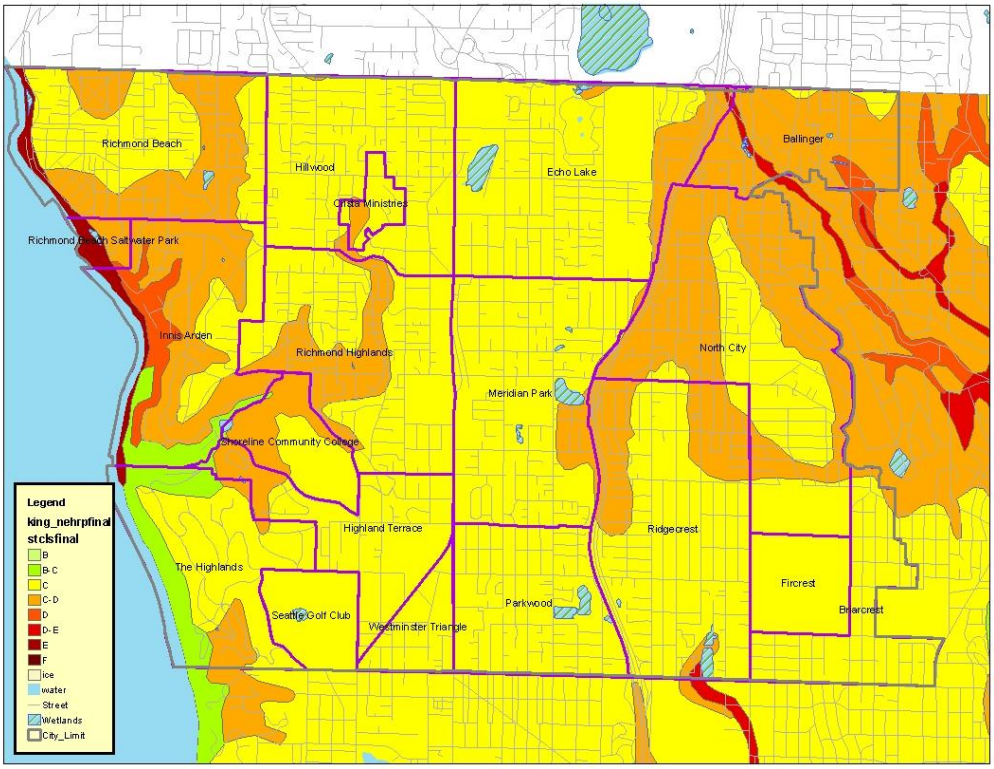
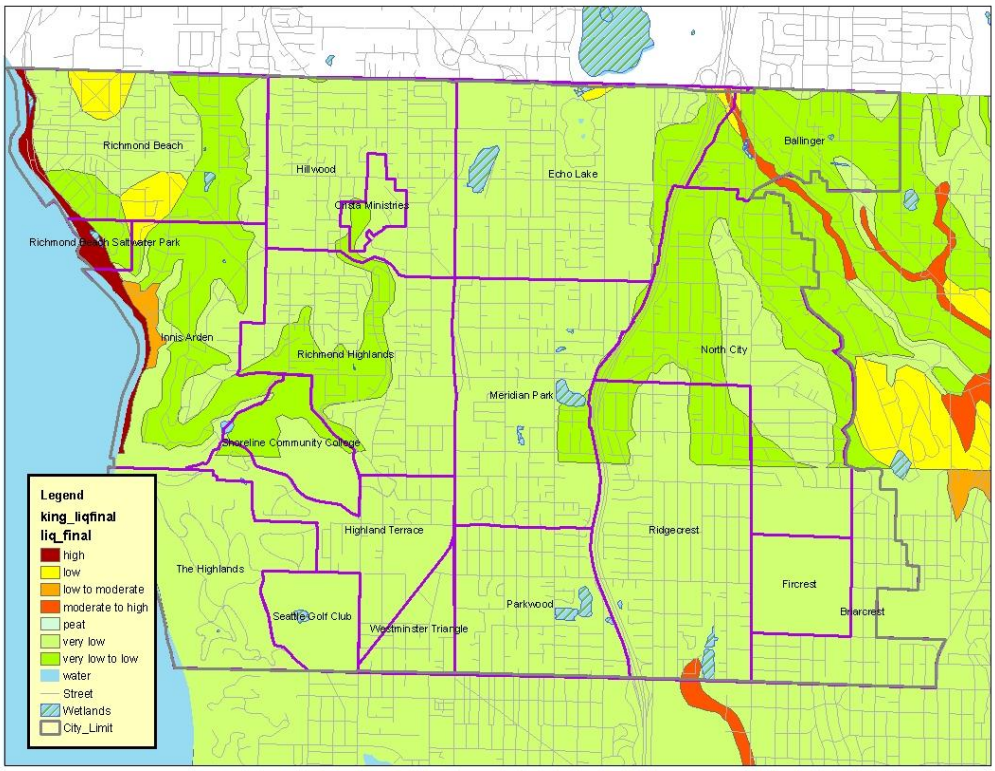


Figure 4-4 Shoreline Liquefaction Map



EXPOSURE AND VULNERABILITY

To determine what structures and systems are exposed and vulnerable to earthquakes, the USGS data shown above was used. More specifically, areas that were located on NEHRP D and E soils and moderate to high and high liquefaction areas were used to quantify what was at risk. In addition to this, HAZUS, a risk assessment software program was used to supplement the data from USGS. HAZUS uses current data along with GIS to produce estimates of hazard-related damage before, or after, a disaster occurs. The 2004 HMP included HAZUS runs for the four types of earthquake affecting the City: Benioff, Subduction Zone, Seattle Fault and Whidbey Island Fault. For the 2009 Plan, a HAZUS run was done reflecting probabilistic Peak Ground Acceleration (GPA) estimates of 0.25 PGA using estimates by Art Frankel (USGS) . HAZUS software can be run at several levels of detail. The runs include with the 2004 and 2009 update reflect the more general first level run. As mentioned previously, specific site and neighborhood levels of detail were developed through the use of NEHRP, land cover and land use data. Based on this, the following information was determined for City of Shoreline earthquake risk. It is important to note that these results, although derived through the use of probabilistic information, do not significantly differ from those include within the 2004 HMP.

- most structures are wooden light single family structure which tend to do better in earthquakes than unreinforced masonry,
- only 10% of the single family structures had more than slight damage, and

- most damage will be to homes of unreinforced masonry construction and to URM elements such as chimneys.

Table 4-5 shows the expected building damage by building type based on the HAZUS run. As noted above, most of the building stock in Shoreline is wood-frame housing. Of the approximate 20,000 buildings in Shoreline (based on 2000 Census); HAZUS found that 54 homes would have complete damage, 227 would have extensive damage and 2,163 would have moderate damage.

Table 4-5 Expected Building Damage by Building Type

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	10,895	96.34	6028	96.61	1,899	87.81	104	45.78	30	54.67
Steel	37	0.33	25	0.40	34	1.57	14	5.98	3	5.36
Concrete	39	0.35	27	0.43	27	1.24	13	5.52	2	4.30
Precast	21	0.18	12	0.19	15	0.71	8	3.36	2	3.82
RM	282	2.50	91	1.46	89	4.13	30	13.04	3	5.08
URM	7	0.06	8	0.13	12	0.55	8	3.60	5	8.69
MH	27	0.24	48	0.77	86	3.98	52	22.73	10	18.09
Total	**11,309**		**6,239**		**2,163**		**227**		**54**	

*Note:
RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

HAZUS also noted that all essential facilities will have greater than 50 % functionality on day one of the earthquake (see Table 4-6). Additionally, there is expected to be some damage to utilities as shown in Table 4-7.

Table 4-6 Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	0	0	0	0
Schools	28	0	0	28
EOCs	0	0	0	0
PoliceStations	1	0	0	1
FireStations	1	0	0	1

Table 4-7 Expected Utility System Pipeline Damage

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	383	93	23
Waste Water	230	74	18
Natural Gas	153	79	20
Oil	0	0	0

Table 4-8 is an output of HAZUS and shows the expected building damage by type of occupancy. The HAZUS Earthquake Event Summary, which provides greater detail regarding vulnerability and loss can be found in Appendix B.

Table 4-8 Expected Building Damage by Occupancy for a Probabilistic Event

Expected Building Damage by Occupancy											
Occupancy	None		Slight		Moderate		Extensive		Complete		Total
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	
Agriculture	6	43%	4	29%	3	21%	1	7%	0	0%	14
Commercial	83	37%	51	23%	56	25%	25	11%	7	3%	222
Education	7	41%	4	24%	4	24%	2	12%	0	0%	17
Government	5	38%	3	23%	3	23%	2	15%	0	0%	13
Industrial	18	36%	11	22%	13	26%	6	12%	2	4%	50
Other Residential	336	42%	217	27%	167	21%	73	9%	15	2%	808
Religion	11	42%	6	23%	6	23%	2	8%	1	4%	26
Single Family	10843	58%	5944	32%	1910	10%	117	1%	29	0%	18843
Total	11309		6240		2162		228		54		19993

Using WADNR data, the vulnerability analysis showed that there are specific neighborhoods that are exposed to greater ground shaking and damage than those in other areas. They are located on softer and more liquefiable soils. Table 4-9 below shows the number of structures vulnerable in exposed neighborhoods.

Table 4-9 Number of Homes Vulnerable in Exposed Neighborhoods

At Risk Neighborhoods	NEHRP	Liquefaction
	D,E and F soils	Moderate to High and High
Ballinger	57	38
Innis Arden	126	29
Ridgecrest	16	26
Richmond Beach	96	78
Totals	295	171

SECONDARY RISKS

Secondary hazards from an earthquake event may be numerous including fire, landslides, tsunamis from landslides and possible hazardous material releases. Landslides do not always occur in the first few minutes following an earthquake but can happen days later. There were numerous landslides during and after the 1949 and 1965 earthquakes. Many roads were closed and sections of the railroad track were swept into Puget Sound as a result of these.

Fires can be caused by downed power lines or ruptured gas lines that occur as a result of an earthquake. As discussed earlier, the HAZUS run showed that there may be leaks or breaks in natural gas. Hazardous materials can be spilled from ruptured containers, accidents can occur during ground shaking, and possible train derailment can occur from buckling tracks or landslides caused by an earthquake.

PROBABLE SCENARIO

A probabilistic event may occur which would likely isolate many residents in many neighborhoods, especially those mentioned earlier. Several homes consisting of unreinforced masonry elements would suffer from damages. The main concentrations of damage would be to those structures on softer, liquefiable soils. The city itself may be isolated from other regions.

LOSS ESTIMATION

Based on the HAZUS Run for a deep earthquake event with a magnitude of 6.5, the total economic loss estimated for the earthquake is 443.12 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory.

BUILDING-RELATED LOSSES

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building

and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 260.87 (millions of dollars); 11 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 70 % of the total loss. Table 4-10 below provides a summary of the losses associated with the building damage. In addition to the loss calculated above, there could be extensive damage to roadways, gas, water, and electric lines, and personal property of other types (cars, home interiors, etc.).

Table 4-10 Building Damage Losses

Category	Area	Single Family ($)	Other Residential ($)	Commercial ($)	Industrial ($)	Others ($)	Total ($)
Income Losses	Wage	0.00	0.91	8.36	0.18	0.74	10.19
	Capital Related	0.00	0.41	7.42	0.10	0.25	8.18
	Rental	2.74	4.20	3.47	0.02	0.31	10.75
	Relocation	0.30	0.10	0.19	0.01	0.12	0.71
	Subtotal	**3.04**	**5.62**	**19.44**	**0.31**	**1.42**	**29.82**
Capital Stock Losses	Structural	16.72	6.88	7.74	0.66	2.24	34.24
	Non Structural	83.25	31.91	20.02	1.91	6.69	143.77
	Content	28.32	7.78	10.33	1.76	4.19	52.38
	Inventory	0.00	0.00	0.28	0.33	0.05	0.66
	Subtotal	**128.28**	**46.57**	**38.37**	**4.65**	**13.17**	**231.05**
Total ($)		131.32	52.19	57.81	4.96	14.59	260.87

TRANSPORTATION AND UTILITY LIFELINE LOSSES

For the transportation and utility lifeline systems, HAZUS computes the direct repair cost for each component only. There are no losses computed by HAZUS for business interruption due to lifeline outages. Table 4-11 and Table 4-12 provide a detailed breakdown in the expected lifeline losses.

Table 4-11 Transportation Losses

System	Component	Inventory Value ($)	Economic Loss ($)
Highway	Segments	150.74	0.00
	Bridges	4041.76	151.54
	Tunnels	0.00	0.00
	Subtotal	4192.50	151.50
Railways	Segments	10.65	0.00
	Bridges	0.00	0.00
	Tunnels	0.00	0.00
	Facilities	0.00	0.00
	Subtotal	10.60	0.00
Total		4203.10	151.1

Table 4-12 Utility Losses

System	Inventory Value	Economic Loss
Potable Water	80.92	8.43

Waste Water	77.86	6.45
Natural Gas	3.06	0.35
Oil Systems	0.11	0.01
Electrical Power	121.00	13.70
Communication	0.11	0.01
Total	283.06	28.96

SEVERE WEATHER AND CLIMATE CHANGE

DEFINITIONS

Blizzard: This is a storm with widespread snowfall accompanied by strong winds. In general, the Cascade Mountain Range acts as a barrier to cold air developing in the eastern part of the state, reducing the likelihood of snowstorms in Shoreline.

Climate Change: Climate includes patterns of temperature, precipitation, humidity, wind and seasons. "Climate change" affects more than just a change in the weather; it refers to seasonal changes over a long period of time. These climate patterns play a fundamental role in shaping natural ecosystems, and the human economies and cultures that depend on them. Scientists from the International Panel on Climate Change (IPCC) predicted that warming oceans and melting glaciers due to global warming and climate change could cause sea levels to rise 7-23 inches by the year 2100. Worldwide, densely populated coastal communities and infrastructure that supports them would be affected (such as city buildings and homes, roads, ports and wastewater treatment plants). Some would be flooded or more vulnerable to storm damage. In flat terrain, the shoreline could move many miles inland[7].

Dry Microburst: This is a severe localized wind blasting down from a thunderstorm. It covers an area less than 2.5 miles in diameter and is of short duration, usually less than 5 minutes.

Flood: When a body of water rises and overflows onto normally dry land.

Ice Storms/Freezing Rain: Ice storms occur when rain falls from warm moist upper layers of the atmosphere into a colder, drier layer near the ground. The rain freezes on contact with the cold ground and accumulates on exposed surfaces.

[7] http://www.ecy.wa.gov/climatechange/whatis.htm

Lightning: An abrupt electric discharge from cloud to cloud or from cloud to earth accompanied by the emission of light.

Mudslide: When soil, rocks and water flow quickly down slopes and canyons during or after a heavy downpour of rain.

Tornado: Tornadoes are characterized by funnel clouds of varying sizes that generate winds as fast as 500 miles per hour. They can affect an area of ¼ to ¾ of a mile, with the path varying in width and length. Tornadoes can come from lines of cumulonimbus clouds or from a single storm cloud. They are measured using the Fujita Scale ranging from F0 to F6.

Windstorms: These are storms consisting of violent winds. There are several sources of windstorms. Southwesterly winds are associated with strong storms moving onto the coast from the Pacific Ocean. Southern winds parallel to the Cascade Mountains are the strongest and most destructive winds. Windstorms tend to damage ridgelines that face into the winds.

BACKGROUND

Severe weather is one of the most damaging natural hazards. Severe weather can bring heavy rain, high winds, snow and ice and lead to storm surges that flood low lying and coastal areas. Severe weather can lead to secondary effects such as landslides, flooding from streams and poor drainage, fires, caused by either ruptured gas lines or down electrical lines and even wildfires, caused by lightening and high winds. King County and the City of Shoreline are subject to various local storms that affect the Pacific Northwest throughout the year, such as wind, snow, ice, hail and potentially tornadoes. Although rare, tornadoes are the most violent weather phenomena known to man. Their funnel shaped clouds rotate at velocities of up to 300 mile per hour and generally affect areas up to a mile wide and seldom more than 16 miles long. Four tornadoes have been sighted in King County since 1950.

Snow storms or blizzards, which are snow storms accompanied by blowing wind or drifting snow, occur occasionally both in Washington State and King County. An ice storm can occur when rain falls out of warm moist upper layer of atmosphere into a dry layer with freezing or sub-freezing air near the ground. Rain freezes on contact with the cold ground and accumulates on exposed surfaces.

Hailstorms occur when freezing water in thunderstorm type clouds accumulate in layers around an icy core. Wind added to hail could batter crops, structures and transportation systems[8]. The most recent severe storm to affect King County occurred over a multi-day period during the end of December 2008 when a snow storm during mid December occurred. This storm shows the potential hazards that can be associated with major storms both primary weather related hazards and secondary hazards including its impacts on infrastructure. This storm included severe snow that closed businesses and impacted travel for several days.

King County and the western part of the Puget Sound region, including Shoreline, are also heavily impacted by windstorms. The most recent was December of 2006 when approximately 85% of the city was without power. Power was restored within one week to all locations. Another storm, struck on January 20, 1993, Inauguration Day. High winds of 67 miles per hour (mph) at Everett and 60mph at

[8] KCEM. http://www.metrokc.gov/prepare/docs/RHMPSEVERESTORMS.pdf

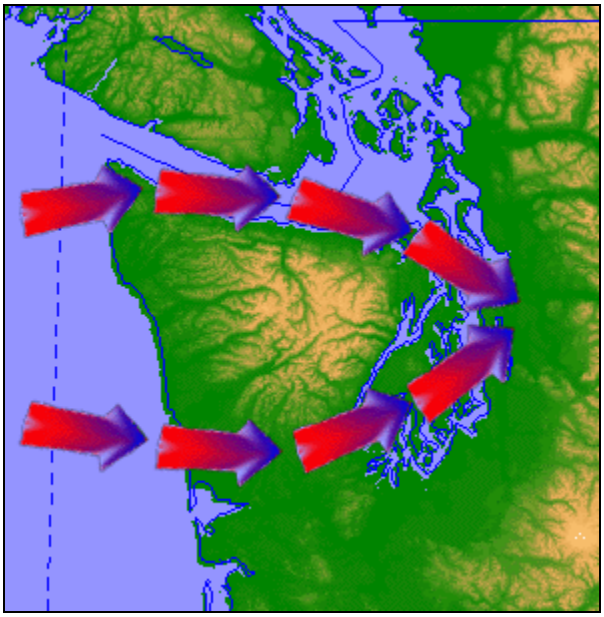
Seatac were noted and caused tremendous destruction of public and private structures, power and telephone lines, and trees; South King County was particularly hard hit. Over 280,000 of Puget Power's King County customers were without electricity; damages to Puget Power facilities were estimated around $17 million.

SEVERE WEATHER IN SHORELINE

The Planning Team used recent disaster data, slope, and landuse information to supplement the 2004 analysis.

Severe weather can affect all areas of Shoreline. Strong wind mainly comes from the west and southwest. The wind flows from high to low sea-level pressure through the Chehalis Gap to the south and the Strait of Juan De Fuca to the north. The convergence of these two wind flows is known as the Puget Sound Convergence Zone. The convergence usually forms in an east-west line across southern Snohomish County but can go as far north as Anacortes or as far south as Federal Way, depending on where the winds collide shows the air flow of the Puget Sound Convergence Zone[9]. Ice will more likely affect those areas at a higher elevation, such as the Highlands or parts of Innis Arden.

Figure 4-5 Convergence Zone



The National Climatic Data Center has collected information about past severe weather events in King County since 1950. There have been a total of 91 events recorded (minus four avalanches events which are not applicable for Shoreline). The events that caused injury, loss of life or property damage are listed in further detail in Table 4-13[10].

The most common problems associated with severe storms are immobility and loss of utilities. Roads may become impassable due to ice, snow, or from a secondary hazard such as a landslide. Power lines may be

[9] http://www-das.uwyo.edu/~geerts/cwx/notes/chap10/oro_rain.html

[10] http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms

downed due to high winds and other services, such as water or phone, may not be able to operate without power. Strong winds have been recorded at 77 knots in King County. Shoreline had a record-breaking day for rainfall on October 20, 2003. Sea-Tac International Airport reported 5.02 inches of rain in a 24 hour period. This caused flooding problems for several homes as well as the closure of some sections of road. Lightning can cause severe damage and can be deadly. Two major concerns for snowfall are dangerous roadway conditions and collapse of structures due to heavy snow load on roofs. The average annual snowfall for Shoreline is 11.7 inches[11]. In addition, ice can create dangerous situations on the roadways as well as freeze pipes.

A meteorologist can often predict the likelihood of an onset of a severe storm. This can give several days of warning time, however, meteorologists cannot predict the exact time of onset or the severity of the storm. Some storms may come on more quickly and have only a few hours of warning time.

CLIMATE CHANGE

Governor Gregoire and the State of Washington, in recognition that our climate is changing and the impacts of the expected changes could be profound, have instructed us to significantly reduce the State's contributions to climate change. - *Washington Climate Change Challenge* (*Executive Order 07- 02*)[12].

In the report "The Preparation and Adaptation Working Groups" (PAWG) our Governor is asking us to incorporate climate change and its impacts into planning and decision-making processes. Accordingly, this Plan will address the impacts of climate change. As a result of extensive research done by the International Panel on Climate Change and University of Washington Climate Impact Group[13], we know that Washington's climate is changing, and the impacts of these projected changes will be far reaching. Although our state is working to significantly reduce its contributions to climate change, some changes cannot (or will not) be prevented. For Redmond, expected changes include:

- Hotter, drier summers
- Wetter winters with increasing rainfall and rain intensity
- Increases in weather extremes

Secondary hazards include increased chance of wildland/urban interface fires, heat waves, insect infestation, drought, potable water shortages, flooding, erosion and landslides.

Scientists expect the Pacific Northwest climate to warm approximately 0.5˚F every ten years over the next several decades. This rate is more than three times faster than the warming experienced during the twentieth century. In Washington, scientists project that average annual temperatures will be 1.9˚F higher by the 2020s when compared with the 1970-1999 average, and 2.9˚F higher by the 2040s. Changes in total precipitation are not projected to be significant over that time period; however, patterns of precipitation will change. Winters will bring more rain and less snow in the mountains.[14]

[11] http://www.cityofshoreline.com/index.aspx?page=44

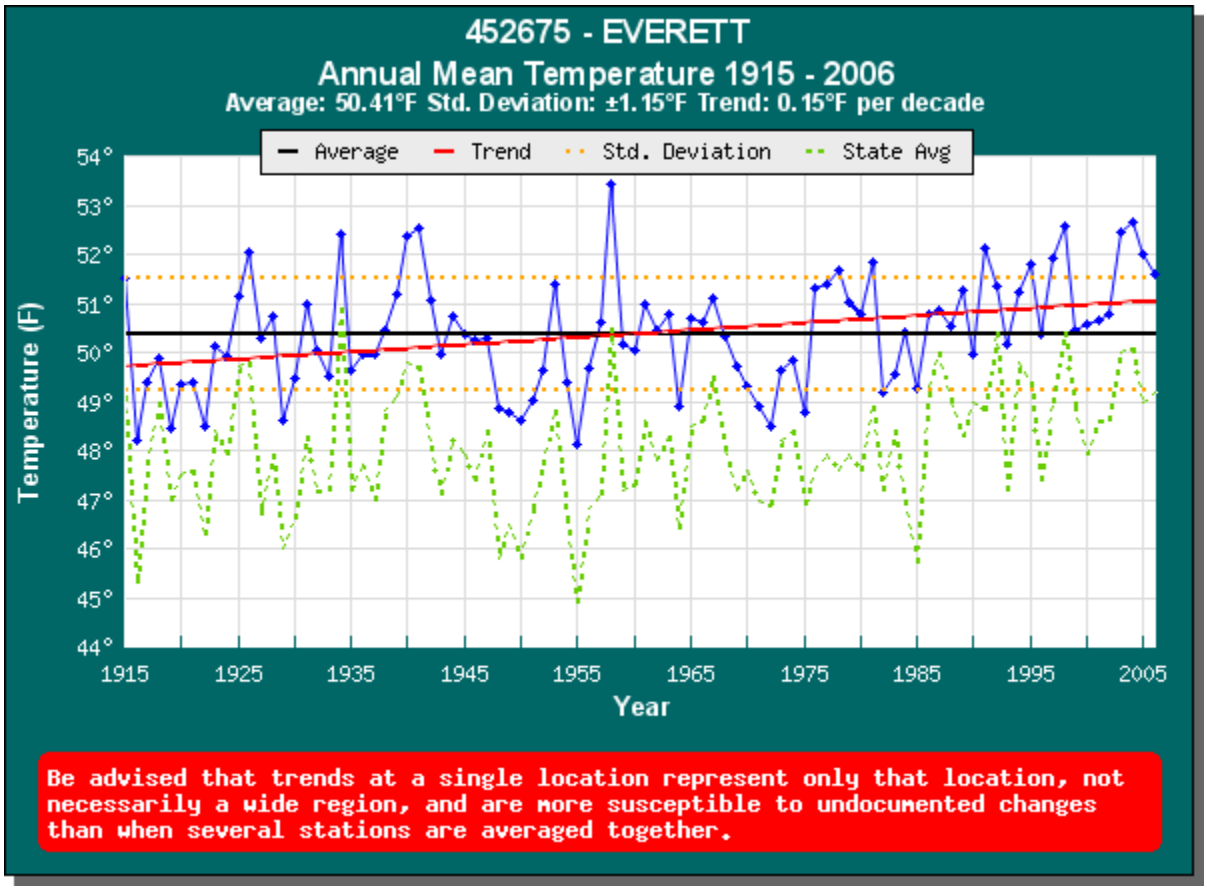
[12] http://www.governor.wa.gov/execorders/eo_07-02.pdf

[13] Global Climate Change Impacts in the United States, Thomas R. Karl, Jerry M. Melillo, and Thomas C. Peterson, (eds.). Cambridge University Press, 2009.

[14] Ibid.

These projections are based on calculations that take into account human contributions to the accumulation of greenhouse gasses. Being human-caused, these projections could be tempered, should efforts be made at reducing greenhouse contributions.[15] While such efforts could slow warming, the impacts would continue for some time.

Figure 4-6 Annual Mean Temperature 1915 to 2006[16]



PAST EVENTS

Shoreline is affected by the same severe weather than can affect King County and the Puget Sound region in general. Table 4-13 is a list of severe storms that affected King County that caused injury, loss of life or property damage between January 1st, 1950 and January 2009. Since the 2004 Shoreline HMP, NOAA has updated each storm event.

[15] http://www.governor.wa.gov/execorders/eo_07-02.pdf

[16] http://www.climate.washington.edu/trendanalysis/graph.php?stnid=452675&stnName=EVERETT&p=annual&d=USHCN_UmeanT&sYR=1915&eYR=2006&dev=true&stavg=true&trend=true&size=false

During the 1993 Inauguration Day Wind Storm, Ronald Wastewater District was without power for several hours at all the pump stations[17]. The 1996-97 Holiday Blast Storm particularly affected Shoreline and the heavy rainfall from it caused a large washout/landslide within Shoreline along NW 175th Street near 6th Avenue NW that was a federally declared disaster. The 100-foot long sinkhole cost $2 million to repair.

Table 4-13 Severe Weather Events Impacting Shoreline [18]

Location or County	Date	Time	Type	Magnitude	Death	Injury	Property Damage
King	3/3/1956	100	Tstm Wind	80 kts.	0	0	0
King	9/28/1962	1957	Tornado	F1	0	0	250K
King	8/18/1964	1245	Tornado	F0	0	0	0K
King	12/12/1969	1615	Tornado	F3	0	1	250K
King	12/23/1969	240	Tstm Wind	0 kts.	0	0	0
King	12/22/1971	1830	Tornado	F	0	0	25K
King	6/8/1972	1820	Hail	1.50 in.	0	0	0
King	10/22/1985	1205	Tstm Wind	0 kts.	0	0	0
King	5/17/1989	2130	Tstm Wind	0 kts.	0	0	0
King	1/25/1993	1800	Flood	N/A	0	0	50K
King	4/25/1993	1835	Heavy Rain	N/A	0	6	50K
King	4/25/1993	1847	Heavy Rain	N/A	0	8	50K
King	8/23/1993	1515	Lightning	N/A	1	0	0
King	3/21/1994	0	High Winds	0 kts.	0	0	0
King	11/1/1994	900	High Winds	0 kts.	0	0	0
King	12/30/1994	500	High Wind	0 kts.	0	0	0
King	1/8/1995	600	Freezing Rain	N/A	0	0	0
King	4/13/1995	1845	Waterspout	N/A	0	0	0
Seattle	12/10/1996	2:30 PM	Lightning	N/A	0	0	4K
Countywide	3/1/1999	12:00 AM	Heavy Rain	N/A	0	0	5.5M
North City	6/1/1999	1:00 PM	Lightning	N/A	0	0	0
Countywide	8/3/1999	6:00 PM	Lightning	N/A	0	2	650K
Countywide	8/21/2001	8:00 AM	Heavy Rain	N/A	0	0	0

[17] CHS Engineers, Inc. 2003. Ronald Wastewater District Hazard Mitigation Plan. October 200*3*

[18] National Oceanic and Atmospheric Administration. (NOAA). National Climatic Data Center (NCDC). Storm Events. http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms

Countywide	11/13/2001	7:00 PM	Heavy Rain	N/A	0	0	0
Countywide	10/20/2003	12:00 AM	Heavy Rain	N/A	0	0	100K
Richmond Beach	3/16/2005	1:29 PM	Funnel Cloud	N/A	0	0	0
North City	12/24/2005	12:00 AM	Heavy Rain	N/A	0	0	10K
Countywide	1/5/2006	12:00 AM	Heavy Rain	N/A	0	0	800K
King*	12/6/2006	-	Severe Winter Storm, Wind, Landslide, Mudslide	N/A	0	0	Not Available
King*	12/7/2007	-	Severe Winter Storm, Landslide, Mudslide	N/A	0	0	Not Available
King*	12/8/2008 (declared in January 2009)	-	Sever Winter Storm, Flood, Landslide, Mudslide	N/A	0	0	Not Available
King*	3/2009		Severe Winter Storm, Record & Near Record Snow	N/A	0	0	Not Available
***Taken from anecdotal information or FEMA declared disasters. No costs are available for that information.**							

Table 4-14 shows the number of days with measurable amounts of snow and rain in the previous eight years.[19] A measurable amount of precipitation is at least 0.01" of rain and ice or 0.1" of snow.

Table 4-14 Annual Counts of Days with Measureable Snow and Rain

Year	Snow	Rain
2008	10	175
2007	7	190
2006	7	186
2005	3	174
2004	3	167
2003	2	180
2002	7	160
2001	0	182
2000	5	166

[19] Office of Washington State Climatology. http://www.climate.washington.edu/climate.html

1999	0	183

EXPOSURE AND VULNERABILITIES

All of Shoreline is vulnerable to severe weather. Neighborhoods located on slopes near the coast including Richmond Beach, Innis Arden, Hillwood, Richmond Highlands are more vulnerable because of their location and limited ingress and egress points creating a possibility of isolation during a severe weather event. The Highlands and Highland Terrace, and the Ballinger and North City; and neighborhoods located on the slopes formed by McAleer Creek are similarly vulnerable and have been isolated during extreme weather events Table 4-13.

Richmond Beach lies near sea level below the bluffs of the city and may be isolated during a snow or ice storm. It can also be affected by a strong storm surge. Properties located along 27th Ave NW would be most affected by a storm surge. The Highlands neighborhood is also vulnerable to isolation due to the topography and limited access points. Power systems may experience downed lines cutting power to residents. Power is lost due to severe storms about four times a year for approximately four to six hours. Trees that are overgrown or have been blown down can create problems for the overhead power lines. The Public Works Department has done a survey and estimates that there are approximately 35,000 trees in Shoreline right of ways. Power outages could result in a disruption to the water systems. Sanitation and water systems could experience contamination or overflow problems.

Figure 4-7 Streets with Steeper Slopes

SECONDARY HAZARDS

The most significant secondary hazards to severe weather are floods, landslides and electrical hazards (fires) from downed power lines. Rapidly melting snow combined with heavy rain can overwhelm both natural and man-made drainage systems, causing overflow and property destruction. Landslides occur when the soil on slopes becomes oversaturated and fails.

PROBABLE SCENARIO

Shoreline would most likely be affected by a combination of a windstorm and snow storm. The heavy wind would knock out power, disrupting some services, such as water pump stations. Downed trees may make some roads inaccessible. Some Richmond Beach residents and residents on other streets would be isolated because the snow and ice makes the steep roads leading down to them impassable. The vast amounts of water draining would overwhelm the sewer system, causing flooding and possible washouts/sinkholes. Land on some of the steeper slopes may give way and also damage homes and block roads.

LOSS ESTIMATION

The total loss for King County over the period spanning from 1962 to January 2006 was 78.590 M. Shoreline can be affected from all the same hazards, only on a smaller scale. For the property damage loss estimation 1% of the value of past losses for King County was calculated. This value is $785,900 and Shoreline's entire population would be affected by severe storms.

FLOODING

DEFINITIONS

Base Flood Elevation: The base flood elevation is the elevation of a 100-year flood event, or a flood, which has a 1% chance of occurring in any given year.

Flood Insurance Rate Map (FIRM): FIRMs are the official maps on which the Flood Insurance Administration has delineated areas of flood risk and risk premium zones.

Floodplain: Floodplains are generally defined as the lands adjacent to major rivers or streams that have a 1% chance of being flooded in any given year. FEMA has mapped these areas throughout the country, and most communities in the United States regulate development within them.

Floodway: Floodways are areas within a floodplain that are reserved for the purpose of conveying flood discharge without increasing the base flood elevation more that one-foot.

Generally speaking, no development is allowed in floodways, as any structures located there would block the flow of floodwaters.

Floodway Fringe: Floodway fringe areas are those lands that are in the floodplain but outside of the floodway. Some development is generally allowed in these areas with a variety of restriction.

Low Impact Development (LID): Low Impact Development is a comprehensive land planning and engineering design approach with a goal of maintaining and enhancing urban and developing watersheds. LID emphasizes conservation and use of on-site natural features to protect water quality. This approach implements engineered small-scale hydrologic controls to replicate the pre-development hydrologic regime of watersheds.

Zero-Rise Floodway: A 'zero-rise' floodway is an area reserved to carry the discharge of a flood without raising the base flood elevation. Some communities have chosen to implement zero-rise floodways because they provide greater flood protection than the floodway described above, which allows a one foot rise in the base flood elevation.

BACKGROUND

Due to its geographical location, Shoreline does not have any of the major rivers in the region that are subject to severe flooding pass through it. Shoreline is drained by one minor stream on the west, Boeing Creek, which flows through the steep bluffs and into Puget Sound and two other minor streams, McAleer Creek and Thornton Creek, which flow in Lake Washington. Boeing Creek and McAleer Creek flow through steep ravines and do not pose much of a hazard to the development above them. Thornton Creek flows through a swampy area parallel to I-5 on the west that has drainage issues and is subject to flooding. The Richmond Beach area is also subject to coastal flooding.

A flood is the inundation of normally dry land resulting from the rising and overflowing of a body of water. It is a natural geologic process that shapes the landscape, provides habitat and creates rich agricultural lands. Human activities and settlements tend to use floodplains, frequently interfering with the natural processes and suffering inconvenience or catastrophe as a result. Human activities encroach upon floodplains, affecting the distribution and timing of drainage, and thereby increasing flood problems. The built environment creates localized flooding problems outside natural floodplains by altering or confining drainage channels. This increases flood potential in two ways: 1) it reduces the stream's capacity to contain flows; and 2) increases flow rates downstream.

There are basically three types of floods (KCEM. http://www.metrokc.gov/prepare/docs/RHMPFLOODS.pdf): 1) a rising flood which occurs because of heavy prolonged rain, melting snow or both (this type of flood can impact on both rural, suburban and urban areas in King County); 2) flash floods which are characterized by quick rise and fall of flood levels; and 3) wind-driven flood tides that combine wind and tides to flood coastal areas.

FLOODING IN SHORELINE

The Planning Team based their analysis on information included within t he 2004 Hazards Mitigation Plan. The Flood Insurance Rate Maps have not changed since the 2004 and no additional areas were mapped. The 2009 planning effort did take advantage of more detailed flooding and landuse data.

Shoreline does not have any of the major rivers in the region that are subject to severe flooding pass through it. Shoreline is drained by one minor stream on the west, Boeing Creek, which flows through the steep bluffs and into Puget Sound and two other minor streams, McAleer Creek and Thornton Creek, which flow in Lake Washington. Boeing Creek and McAleer Creek flow through steep ravines and do not pose much of a hazard to the development above them. Thornton Creek flows through a swampy area

parallel to I-5 on the west that has drainage issues and is subject to flooding. The lowlands of the Richmond Beach area are also subject to coastal flooding.

Structures located on properties within the FEMA 100-year floodplain have a 1% chance in any given year to experience flooding. Although, Boeing Creek is a mapped floodplain, none of the homes in the mapped floodplain have experienced flooding because they are located above the steep ravine through which the stream flows. Flooding in Shoreline occurs mainly from not enough capacity in the water system during heavy rains. This has led to flooding in roadways and several homes being flooded. The extent of the damage to the homes is undetermined at this time. There usually are between 12 and 24 hours warning time but it depends on the extent of the flooding. Most of the past flooding problems are related more to poor drainage and presence of impervious soils than to development in delineated floodplains.

The City of Shoreline is an active member of the National Flood Insurance Program (NFIP), but no structures have been built or substantially improved with in designated flood hazard areas since the community joined the program. There are no structures within Shoreline meeting the FEMA repetitive flood loss definition. At the time this 2009 HMP update was written there were only two NFIP policy holders in Shoreline and no claims had been filed. Shoreline is in good standing with the NFIP and will continue to its compliance with the Program.

Specifically the area near Ronald Bog has had flooding problems almost every year. With development of the Surface Water Master plan, improvements have been made to alleviate many of these storm water issues. This area has not be designated a Special Flood Hazard Area (SFHA) by FEMA, There are two Flood Insurance Policy holders with in the undesignated floodprone Ronald Bog area, however these insured structures do not qualify as repetitive loss structures. More specific information regarding mitigation measures is located at the City of Shoreline website, http://www.shorelinewa.gov/index.aspx?page=24.

Flooding in Shoreline is largely a result of surface water collecting in repressions with impermeable soils. The City has prepared a Shoreline Surface Water Master Plan and has adopted the Washington Low Impact Development manual to address surface water concerns.

Shoreline has two repetitive loss properties identified on the FEMA repetitive loss inventory. The property located on 27th Ave. NW has three claims for a total of $33,600. The property located on Richmond Beach Rd. has four claims for a total of $13,900.Each are reported as having multiple insurance claims, but these looses predate the 2004 HMP. As of the writing of this Update, there were no insured properties having more than one claim under the National Flood Insurance Program.

PAST EVENTS

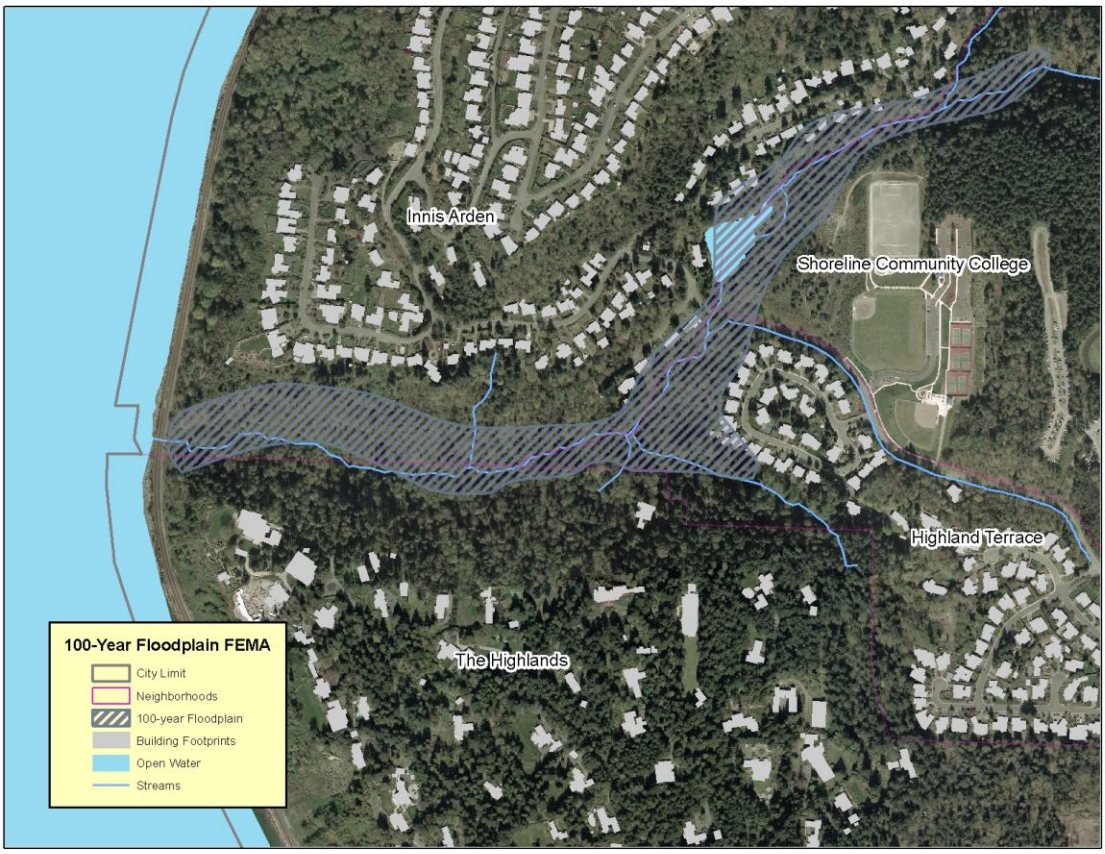
Shoreline has not been affected by major flooding for the majority of presidentially declared disasters. However, the residential area south of Ronald Bog, has historically experienced urban flooding during significant rain evens greater than a 50 year storm (December 1996, February 1997 and November 2006). Most recently, this neighborhood was flooded during the December 2007 rain storm.

EXPOSURE AND VULNERABILITY

The types of property and infrastructure that are vulnerable to flooding in Shoreline are properties along the coast and properties with poor drainage.

Analysis shows that there is one FEMA designated floodplain in Shoreline, along Boeing Creek. Figure 4-8 displays the FEMA mapped floodplain in Shoreline. This designated floodplain may not be accurate as the 18 structures located within it have never been flooded and are built upon the bluff of Boeing Creek.

Figure 4-8 FEMA 100-Year Floodplain



Properties along the coast may experience coastal flooding during a strong storm surge. Most vulnerable are the properties along 27th Avenue NW and the BNSF railroad tracks. Two main flooding problem areas that the City has identified and already begun working to solve are the Ronald Bog subbasin in the Thornton Creek Basin and the 3rd Avenue NW subbasin in the Boeing Creek Basin. Residents of the Ronald Bog subbasin have experienced frequent flooding of arterials, streets, yards, and homes. Over 20 residents between 3rd and 6th Avenues NW have also experienced frequent flooding during moderate storms.

Most of the identified flooding problems result from inadequate capacity of the existing drainage system, lack of a formal drainage system, and/or lack of adequate detention to mitigate for development. The 2005 Surface Water Master Plan identifies the location of the known flood problems. In addition, based on a priority list the city developed, projects were identified to mitigate these problems. The areas of priority are:

1. providing flood protection from stormwater impacts,
2. protecting water quality and

3. preserving stream habitat for aquatic species[20].

SECONDARY HAZARDS

Secondary hazards include landslides, which can occur as a result of flooding when the ground is saturated. Landslide hazards are discussed in the landslide section. Additionally, chemicals or other toxic substances stored without appropriate protection may be released into floodwaters. Septic systems may cause additional water contamination.

PROBABLE SCENARIO

A severe storm with heavy precipitation during a generally wet cold winter that leaves the ground frozen and impervious would be a worse case scenario for flooding in Shoreline.

The drainage system would go over capacity, spilling into streets, basements and low-lying areas. Damage would include flooded basements and damaged underground utilities especially in those locations of the Ronald Bog Area.

LOSS ESTIMATION

In Shoreline, the FEMA map floodplain is not accurate, however, it has been reported that there is an average of 40 homes that experience flooding each year. To calculate the structure damage for flooding, first the median value of a single-family owner occupied home in Shoreline, $315,900, was multiplied by 40[21]. This gave a value of $12,636,000, which was then multiplied by an estimated loss of 15%. The 15% value was taken from the FEMA State and Local Mitigation Planning How-to-Guide (2001). It was assumed that the houses that experience flooding are 1 to 2 stories with basements and that the flood level was 1 foot. This produced a loss estimation for structures of $1,895,400. To calculate the number of people that would be affected, the average household size in Shoreline, which is 2.5 (US Census Bureau. 2000), was multiplied by 40, the average number of homes that experience flooding in Shoreline. The number of people affected by flooding is 100.

LANDSLIDES AND SINKHOLES

DEFINITIONS

Debris Slides: Debris slides consist of unconsolidated rock or soil that has moved rapidly down slope. They occur on slopes greater than 65%.

[20] http://www.shorelinewa.gov/index.aspx?page=541

[21] http://www.zillow.com/local-info/WA-Shoreline-home-value/r_54409/

Earthflows: Earthflows are slow to rapid down slope movements of saturated clay-rich soils. This type of landslide typically occurs on gentle to moderate slopes but can occur on steeper slopes especially after vegetation removal.

Landslide: Landslides can be described as the sliding movement of masses of loosened rock and soil down a hillside or slope. Fundamentally, slope failures occur when the strength of the soils forming the slope exceeds the pressure, such as weight or saturation, acting upon them.

Rock falls: A type of landslide that typically occurs on rock slopes greater than 40% near ridge crests, artificially cut slopes and slopes undercut by active erosion.

Rotational-Translational slides: A type of landslide characterized by the deep failure of slopes, resulting in the flow of large amounts of soil and rock. In general, they occur in cohesive masses and are usually saturated clayey soils.

Sinkhole: A collapse depression in the ground with no visible outlet. Its drainage is subterranean; its size typically measured in meters or tens of meters, and it is commonly vertical-sided or funnel-shaped.

BACKGROUND

The term landslide refers to the down slope movement of masses of rock and soil. Landslides are caused by one or a combination of the following factors: change in slope gradient, increasing the load the land must withstand shocks and vibrations, change in water content, ground water movement, frost action, weathering of rocks, and removal or changing the type of vegetation covering slopes.

The soil covering much of King County was left behind by the Vashon Glacier and is prone to slides. The top layer, Vashon till, is a stable mix of rocks, dirt, clay and sand that has the consistency of concrete and can be found to depths up to 30 feet. The next layer, Esperance sand, is a permeable mixture of sand and gravel. This sits upon an impermeable layer of clay, Lawton clay, made up of fine sediments and large boulders. It is this boundary between the clay and sand in which sliding occurs; water percolates through the sand and runs laterally on top of the denser clay. "The buildup of water pressure floats the sand above the clay creating lubrication for a deep-seated slide[22]."

Landslide hazard areas occur where the land has certain characteristics, which contribute to the risk of the downhill movement of material. These characteristics include[23]:

- A slope greater than 15 percent.
- Landslide activity or movement occurred during the last 10,000 years.
- Stream or wave activity, which has caused erosion, undercut a bank or cut into a bank to cause the surrounding land to be unstable.
- The presence or potential for snow avalanches.

[22] Carter, Don and Scott Maier. 1997. Seattle Times. Slide-Wise, Danger Remains Real as Soggy Slopes are Still Unstable. January 17, 1997. p A8.
[23] King County. 1990. Planning and Community Development Division. Landslide Hazard Areas. Sensitive Areas: Map Folio. Seattle Washington. p 1

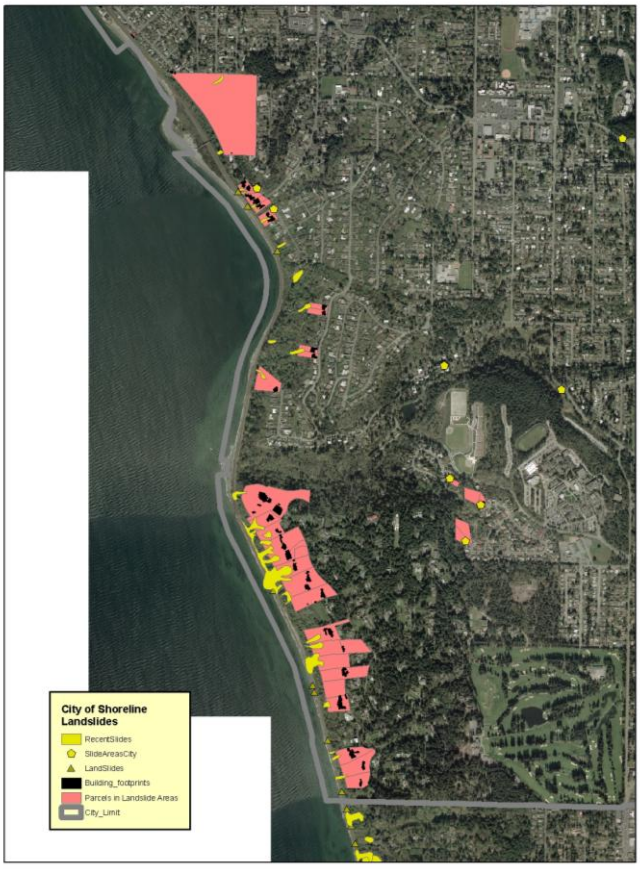
- The presence of an alluvial fan, which indicates vulnerability to the flow of debris or sediments
- The presence of impermeable soils, such as silt or clay, which are mixed with granular soils such as sand and gravel.

LANDSLIDE HAZARD IN SHORELINE

The 2009 landslide analysis took advantage of new land use and land slide data to build on information available within the 2004 HMP.

Four types of landslides can potentially affect Shoreline. They are deep-seated, shallow, bench and large slides. Puget Sound's shoreline contains many large, deep-seated dormant landslides. Shallow slides are the most common type and the most probable for Shoreline. Occasionally, large catastrophic slides occur on Puget Sound. Figure 4-9 is a map of the landslide hazard areas for Shoreline and the structures located in the landslide hazard area.

Figure 4-9 Landslide Hazard Area



Landslides are often triggered by other natural hazards such as earthquakes, heavy rain, floods or wildfires. The frequency of a landslide is related to the frequency of earthquakes, heavy rain, floods, and wildfires. In the past, Shoreline has experienced two landslides which are described in further detail in the past events section. King County experienced over 100 landslides during December 1996 and January

1997 and also experienced numerous landslides in 1972 that totaled $1.8 million in damages (KCEM. http://www.metrokc.gov/prepare/docs/RHMPLANDSLIDES.pdf.)

Landslides destroy property, infrastructure, transportation systems, and can take the lives of people. Slope failures in the United States result in an average of 25 lives lost per year and an annual cost to society of about $1.5 billion (ibid). Landslides can occur either very suddenly or slowly. There is no way to predict when or where a specific landslide will occur, but it is possible to determine what areas are at risk during general time periods. Assessing the geology, vegetation, and amount of predicted precipitation for a given area can help in these predictions.

PAST EVENTS

A large slide occurred in the town of Woodway, just north of the Richmond Beach neighborhood during the early morning of January 15th, 1997 (see Figure 4-10). It cut fifty feet into the property above, passed over the railroad tracks and knocked a freight train into the Sound[24].

Figure 4-10 Woodway Slide 1997

The Holiday Blast Storm of December and January 1996-1997 was the cause of this massive landslide. The storm also caused a large washout/landslide within Shoreline along NW 175th Street near 6th Avenue NW that was a federally declared disaster (see Figure 4-11). The 100 foot long sinkhole cost 2 million dollars to repair. However, the sinkhole provided opportunities to implement a series of Low Impact Development concepts ultimately reducing flooding and water quality problems while increasing fish habitat and providing recreation opportunities (see Figure 4-12). The effort was developed as an element of the City Comprehensive Surface Water Master Plan and was completed in 2009.

[24] http://www.ecy.wa.gov/programs/sea/landslides/show/woodway.html

Figure 4-11 Holiday Blast Storm Sinkhole - Shoreline

Figure 4-12 Boeing Creek Detention Basin/Passive Recreation Project, Fall 2008

In the late 1990's a landslide near Perkin's Way and 23rd Avenue NE damaged Shoreline Water District's water main and cost the District $23,142[25].

EXPOSURE AND VULNERABILITY

[25] RH2. 2003. Draft Shoreline Water District Hazard Mitigation Plan. October 21, 2003.

Analysis showed that there were 40 parcels that contained structures located in the landslide hazard area. The total taxable land value for these parcels is $41,148,900; the total taxable improvements value is $56,767,100, with a total taxable value of $97,916,000. Thirty eight of these homes are single-family homes, one is a park and one is vacant land.

Besides structures located on landslide areas, lifelines and infrastructure can be affected. Many roads cross through the landslide area. It is also important to note that the BNSF railroad tracks cross through the landslide hazard area. Not only can a landslide disrupt service, it can cause train derailments, which can potentially lead to a secondary hazard of a hazardous materials release and fire. BNSF has had problems with slides for many years. They have installed landslide alarms that go between milepost 8 and milepost 32. The alarms consist of two strand wire fences that when triggered turn all the lights red on that section of track and this tells the trains to stop. Someone then checks to see what triggered the alarm and whether it is safe to proceed. This helps to prevent train derailments when a landslide occurs.

SECONDARY HAZARDS

Landslides can typically cause several different types of secondary effects. Landslides can block egress and ingress on roads. This has the potential to cause isolation for affected residents and businesses. Roadway blockages caused by landslides can also create traffic problems resulting in delays for commercial, public and private transportation. This could result in economic losses for businesses. A landslide could also block the BNSF Railroad and this could result in a release of hazardous materials or fire.

Other potential problems resulting from landslides are power and communication failures. Vegetation on slopes or slopes supporting poles can be knocked over resulting in possible losses to power and communication lines. This, in turn, creates communication and power isolation. Landslides have the potential of destabilizing the foundation of structures that may result in monetary loss for residents. It is possible for landslides to affect environmental processes. Landslides can damage rivers or streams, potentially harming water quality, fisheries and spawning habitat.

PROBABLE SCENARIO

A landslide may occur during or more likely a few days or weeks after a severe storm that saturates the ground. A shallow slide would occur that would damage some homes and some underground infrastructure. Some roads may be blocked. A worse-case scenario would be a large slide similar to the Woodway slide where a large mass of landslides along the developed bluffs of Shoreline, destroying homes and the railroad tracks. If it happens unexpectedly it could also cause the derailment of a train carrying hazardous materials, which then are released into Puget Sound, polluting the surrounding environment.

LOSS ESTIMATION

The loss estimation for property damage for landslides was calculated by multiplying the assessed value for parcels in the landslide hazard by 10%. The damage of 10% was chosen because in past landslide events in Shoreline there has not been much damage to structures. Most of the damage of past landslide has been toward infrastructure. The loss estimation for structures in landslide is $9,791,600. Number of people affected was calculated by multiplying the number of structures in the hazard, 40, by the average

household size in Shoreline, which is 2.5 according to the 2000 Census. This gives a figure of 100 people affected.

WILDLAND FIRE

DEFINITIONS

Intermix Area: An area susceptible to wildland or forest fires because wildland vegetation and urban or suburban development occur together (Slaughter, R. 1996).

Wildland fires: This term refers to any uncontrolled burning of grasslands, brush or woodland areas.

BACKGROUND

Triggers that can cause fire are both natural, such as lightning, and human induced. Humans can directly cause fires with careless campfires, sparks from ATVs, or inappropriate disposal of lit cigarettes. Downed electric lines during windstorms can also cause fires. Fires are influenced by the amount and condition of fuel present, slopes, wind and temperature. Fires advance through the transmission of heat in the form of conduction, convection and radiation. During the day, fires generally travel uphill. Convection currents and radiation ahead of the fire preheat the fuels and air upslope, allowing the fire to expand rapidly. Radiation has an extreme impact when the fire enters a "chimney," or a v-shaped area on a slope, such as a drainage gully. Additionally, south and west facing slopes tend to be warmest and driest. The situation of heavy dry fuels, on a southwest facing slope with chimneys on a hot day will allow for near explosive expansion of the fire. Wind can strengthen and spread a fire, though large fires can generate their own wind. The heat rising from a large fire will create a thermal column that can rise hundreds or thousands of vertical feet. These vertical columns carry burning embers that are often picked up by prevailing winds and spread. At night, the fire will slow and travel downhill following the cooling airflow.

Fire experts attribute the generally worsening fire risk to increases in the presence of dry, hazardous fuel. Wildfires are most likely to occur between mid-May and October but can occur at any time during the year. Any particularly dry period can increase vulnerability. The probability of a fire in any one locality on any particular day depends on fuel conditions, topography, the time of year, the past and present weather conditions, and the activities (debris burning, land clearing, camping, etc.) that take place in the vicinity. Fires in general can range from isolated burns affecting a few acres or less to severe events. These large fires usually occur when groups of smaller fires merge. With the presence of such conditions, lighting on dry fuels, recreational uses, interface development or terrorist acts can all trigger fires. The type of ignition (man-made or natural) should be discounted in evaluating the risk. If the conditions are right in a forest for a major fire, any source of ignition (whether natural or human caused) will bring about the same end results.

FIRE IN SHORELINE

The 2009 HMP update took able of new land cover data to supplement that included within the 2009 Wildland Fire analysis.

Shoreline is an urbanized city but is susceptible to wildland fires that can destroy property and infrastructure. This analysis differs from most wildfire analyses in that Shoreline does not lie in an urban interface/intermix area, and does not have a specified wildfire hazard zone. Nonetheless it is a pertinent risk. The City of Shoreline is susceptible to fires as a result of the numerous steep slopes located throughout. Innis Arden, the Highlands, and Boeing Creek Canyon all have vegetated areas located on slopes. These tend to be heavily vegetated and typically dry out during the summer.

Shoreline also has a utility corridor parallel to Aurora Avenue, which used to be the Interurban right of way (and is currently being converted to a bike path) that is not maintained and contains grassy/brush areas. In addition, the brush along Interstate 5 can also potentially catch fire.

Richmond Beach Park, which faces south, is vulnerable to wildfires. Shoreline also has other pocket areas located on steep slopes or have high fuel loads that have not been specifically identified as of yet but can potentially cause damage.

Richmond Beach Park, which faces south, has brush fires approximately every five years. However, urban and brush fires can occur at anytime and are more probable during dry, summer months. Fires can burn vegetation and cause loss of life and personal property. Loss of vegetation due to fires may cause erosion and mudslides. There is strong concern for occupants in structures that may catch fire. Fires may also cause the release of hazardous materials and damage utility lines. The onset of a fire can be sudden and there can be little warning time. The warning time is dependent on the extent of the fire and the speed the fire is traveling.

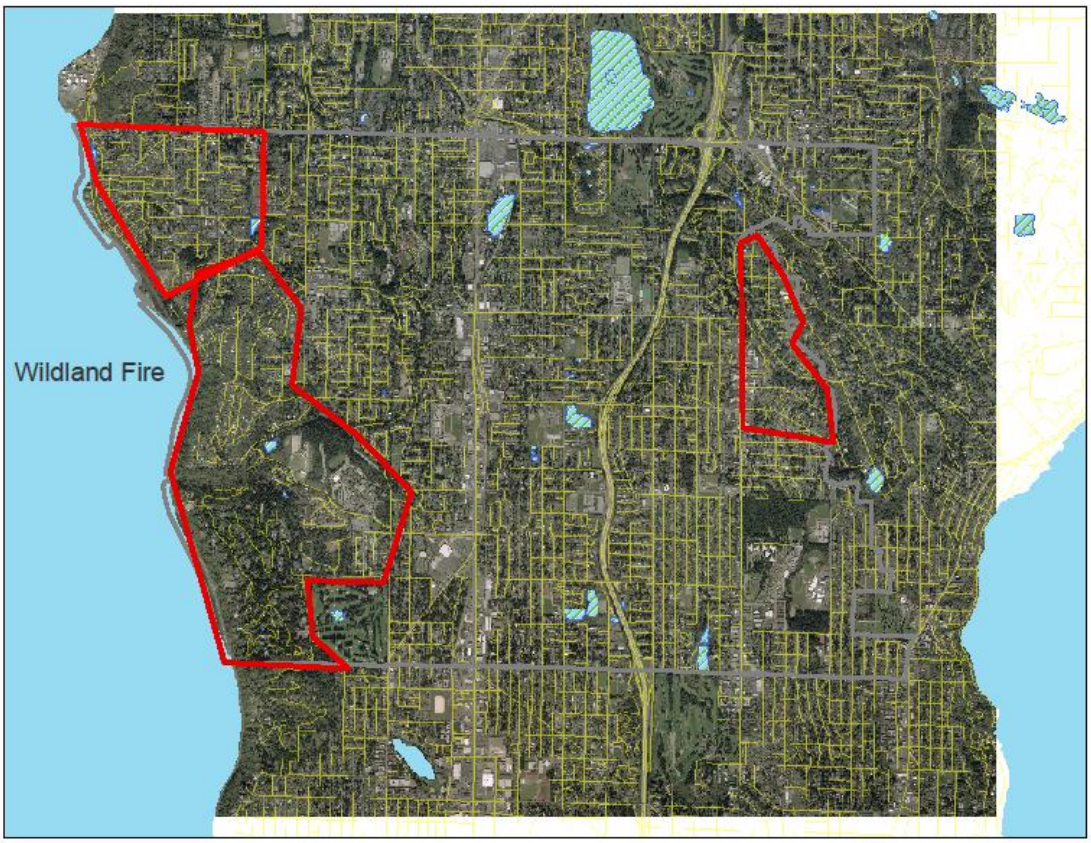
In the late 1960's there was a brush fire in the Boeing Creek Canyon area. This area is highly inaccessible for fire vehicles. On July 5th, 2003 two fires burned 1.5 acres of brush between the Burlington Northern Railroad tracks and the beach at Richmond Beach Saltwater Park. The pedestrian bridge located there was threatened but the fire was put out in enough time so that there was only minimal damage to the bridge[26].

The utility corridor parallel to Aurora Avenue caught fire on August 18, 2003 scorching a path between N 165th Street and N 160th Street. The fire damaged the exterior of two homes and twelve other property owners reported damage to backyards, outbuildings and landscaping[27]. Figure 4-13 shows areas where slopes and landcover may contribute to increased wildland fire risks.

[26] Enterprise. 2003. Fires at Richmond Beach—fireworks may be to blame. July 11, 2003.

[27] Enterprise. 2003a. Cigarette caused Shoreline brush fire. August 29, 2000.

Figure 4-13 Areas where slopes, landcover contribute to increased wlidland fire risks



EXPOSURE AND VULNERABILITY

There is any number of vulnerabilities to fires in Shoreline. These fires can spread to homes, businesses, block road and lifelines and create significant economic and environmental damage if fuel loads and vegetation are not properly maintained. Specific areas that, such as Richmond Beach Park is especially vulnerable. In addition, the Highlands neighborhood is a highly vegetated area with potential high fuel loads and limited ingress and egress for emergency vehicles. Vegetated areas in Innis Arden and south of Richmond Beach may also be an area of concern. A steep slopes and land cover map may help to determine general wildland and brush fire hazard locations in Shoreline.

SECONDARY HAZARDS

Due to the presence of steep slopes, erosion after a wildfire is a risk that may potentially lead also to landslides. The protection provided by foliage and organic matter is removed, leaving the soil fully exposed to wind and water erosion.

PROBABLE SCENARIO

A disastrous fire could be caused by a lightning strike or more likely by human error. It would be an extremely dry hot summer and someone would discard a cigarette out the window of a car on Interstate 5 or along the bike path. It is also possible that fires can be set at Richmond Beach Park or the Highlands. Because of the dry conditions and steep slopes, the fire would spread very rapidly, especially if it is a windy day. It spreads before response teams can contain it and then moves in to neighborhoods, sparking a wave of fires that destroys or damages numerous homes.

LOSS ESTIMATION

Loss from exposure to wildland fire in Shoreline is difficult to calculate without the completion of technical studies of interface areas. Shoreline has a variety of wildland areas and depending on conditions the loss could be very different. Extents of wildland fires are also often dependent on weather conditions such as wind and dryness of vegetation. Some wildland fires, would result in no loss to property and very little clean up expenditure (a loss estimate very near to $0), while others could result in loss of life, expensive emergency response and damage figures ranging from thousands to millions of dollars. Given this variety, it is difficult to assess exposure to wildland fires with enough specificity to allow loss estimation.

VOLCANO

DEFINITIONS

Ashfall: Volcanoes tend to erupt lavas so thick and charged with gases that they explode into ash rather than flow.

Debris Avalanches: Volcanoes are prone to debris and mountain rock avalanches that can approach speeds of 100 mph.

Debris Flows: Dense mixtures of water-saturated debris that move down-valley; looking and behaving much like flowing concrete. They form when loose masses of unconsolidated material are saturated, become unstable, and move down slope. The source of water varies but includes rainfall, melting snow or ice, and glacial outburst floods.

Lahars: Lahars are rapidly flowing mixtures of water and rock debris that originate from volcanoes. While lahars are most commonly associated with eruptions, heavy rains, debris accumulation, and even earthquakes may also trigger them. They may also be termed debris or mud flows.

Lateral blasts: These are explosive events in which energy is directed horizontally instead of vertically from a volcano. They are gas charged, hot mixtures of rock, gas and ash that are expelled at speeds up to 650 mph.

Lava Flows: Lava flows are normally the least hazardous threat posed by volcanoes. Cascades volcanoes are normally associated with slow moving andesite or dacite lava.

Pyroclastic Flows and Surges: Pyroclastic flows are avalanches of hot (570-1470° F), ash, rock fragments and gas that move at high speeds down the sides of a volcano during explosive eruptions or when the edge of a thick, viscous, lava flow or dome breaks apart or collapses. Speeds range from 20 to more than 200 miles per hour.

Stratovolcano: The volcanoes in the Cascade Range surrounding Shoreline are all stratovolcanoes. They are typically steep-sided, symmetrical cones of large dimension built of alternating layers of lava flows, volcanic ash, cinders, blocks, and bombs and may rise as much as 8000 feet above their bases (USGS. http://vulcan.wr.usgs.gov/Glossary/StratoVolcano/description_composite_volcano.html).

Tephra: The ash and the large volcanic projectiles that erupt from a volcano into the atmosphere are called tephra. The largest fragments 2½ inches) fall back to the ground fairly near the vents, as close as a few feet and as far as 6 mi. The smallest rock fragments (ash) are composed of rock, minerals, and glass that are less than 1/8 inch in diameter. Tephra plume characteristics are affected by wind speed, particle size, and precipitation.

Volcanic Gases: All active volcanoes emit gases. These gases may include steam, carbon dioxide, sulfur dioxide, hydrogen sulfide, hydrogen, and fluorine.

BACKGROUND

A volcano is a vent in the Earth from which molten rock (magma) and gas erupts. There are a wide variety of hazards related to volcanoes and volcanic eruptions. With volcanic eruptions, the hazards are distinguished by the different ways in which volcanic materials and other debris flow from the volcano. The molten rock that erupts from the volcano (lava) forms a hill or mountain around the vent. The lava may flow out as a viscous liquid, or it may explode from the vent as solid or liquid particles.

VOLCANIC HAZARDS IN SHORELINE

The risks associated from volcanic hazard remains largely unchanged from that included within the 2005 HMP.

The Cascade Range is a 1,000 mile long chain of volcanoes, which extends from northern California to southern British Columbia. Shoreline does not lie within any basin that would drain any lahars or mudflows from the nearby volcanoes. Nonetheless it would be affected by tephra or an ash fall from either a Mount Rainier or Glacier Peak eruption.

Volcanoes in the Cascades erupt at a rate of 1 or 2 eruptions every 200 years. Many of these volcanoes have erupted in the recent past and will erupt again in the foreseeable future. Eruptions in the Cascades have occurred at an average rate of 1-2 per century during the last 4,000 years. The USGS classifies Glacier Peak, Mount Adams, Mount Baker, Mount Hood, Mount St. Helens and Mount Rainier as being potentially active Washington state volcanoes. Mount Saint Helens is by far the most active volcano in the Cascades, with four major explosive eruptions in the last 515 years.

A one-inch deep layer of ash weighs an average of ten pounds per square foot causing danger of structural collapse. Ash is harsh, acidic, gritty, and smelly. Ash may also carry a high static charge for up to two days after being ejected from a volcano. An ash cloud combines with rain, sulfur dioxide in the cloud

combines with water to form diluted sulfuric acid that may cause minor, but painful burns to the skin, eyes, nose, and throat.

Constant monitoring of all active volcanoes means that there will be more than adequate time for evacuation before an event. Since 1980, Mount St. Helens has settled into a pattern of intermittent, moderate and generally nonexplosive activity, and the severity of tephra, explosions, and lava flows have diminished. All episodes, except for one very small event in 1984, have been successfully predicted several days to 3 weeks in advance. However, scientists remain uncertain as to whether the current cycle of explosivity has ended with the 1980 explosion. The possibility of further large-scale events continues for the foreseeable future[28].

PAST EVENTS

The most famous of past eruptions for Mount Saint Helens occurred May 18, 1980. In this eruption, the elevation of Mount Saint Helens dropped dramatically from 9,677 feet to 8,364 feet; 23 square miles of volcanic material buried the North Fork of the Toutle River to an average depth of 150 miles. A total of 57 human fatalities resulted from the blast[29]. The following table (Table 4-15) summarizes the eruptions in the area:

Table 4-15 Volcanic Eruptions in Region

Volcano	Number of Eruptions	Type of Eruptions
Mount Adams	3 in the last 10,000 years, most recent between 1,000 and 2,000 years	Andesite lava
Mount Baker	5 eruptions in past 10,000 years; mudflows have been more common (8 in same time period)	Pyroclastic flows, mudflows, ashfall in 1843.
Glacier Peak	8 Eruptions in last 13,000 years	Pyroclastic flows and lahars
Mount Rainier	14 eruptions in last 9,000 years; also 4 large mudflows	Pyroclastic flows, mudflows, lava and ashfall
Mount St. Helens	19 eruptions in last 13,000 years	Pyroclastic flows, mudflows, lava and ashfall

SECONDARY HAZARDS

[28] Tilling, Robert I., Lyn Topinka, and Donald Swanson. 1990. Eruptions of Mt. Saint Helens: Past, Present and Future. USGS Special Interest Publication.
[29] Brantley and Myers. 1997. Mount St. Helens -- From the 1980 Eruption to 1996. USGS Fact Sheet 070-97.

In Shoreline, the most likely secondary hazards associated with volcanic eruptions are disruption of traffic and loss of services.

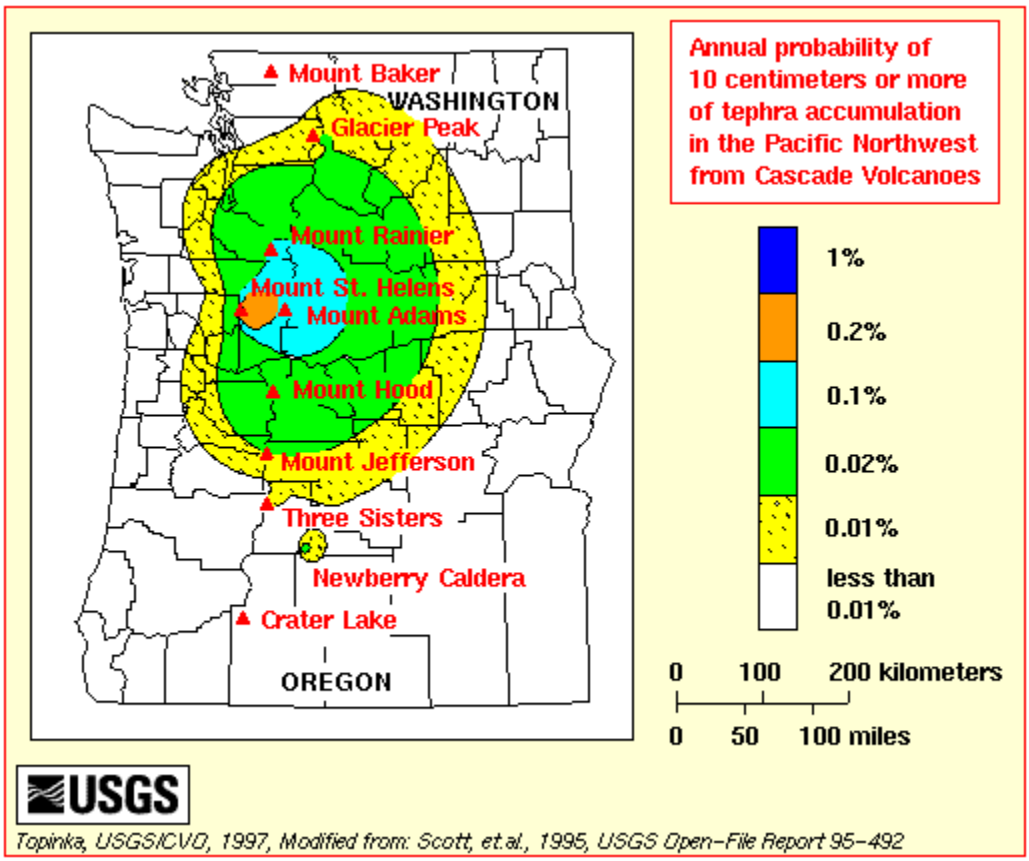
EXPOSURE AND VULNERABILITY

Shoreline has low vulnerability to volcanic hazards. Tephras can potentially cause the most damage. Ash only ½ inch thick can impede the movement of most vehicles and disrupt transportation, communication, and utility systems. Tephra may cause eye and respiratory problems, particularly for those with existing medical conditions. Ash may also clog ventilation systems and other machinery. It is easily carried by winds and air currents remaining a hazard to machinery and transportation long after the eruption.

When tephras are mixed with rain it becomes a much greater nuisance because wet ash is much heavier, more difficult to remove, and can even cause structures to collapse. Heavy ashfall can drift into roadways, railways, and runways where it becomes slippery and dangerous. Wet ash may also cause electrical shorts. Power lines can be destroyed and roofs may collapse from the ashfall loads. Ash fall also decreases visibility and may cause psychological stress and panic. Figure 4-14 below depicts the probability of ash accumulation from a Cascade volcano. As is evident, there is little likelihood of major accumulation, but some should be expected. An ash fall may cause secondary hazards such as fire or flooding. The weight of ash may cause structural collapse.

Vulnerable populations are the elderly, children, and those with weakened immune and respiratory systems. Gases from volcanic eruptions are usually too diluted to constitute danger to a person in normal health, the combination of acidic gas and ash may cause lung problems. Extremely heavy ash can clog breathing passages and cause death.

Figure 4-14 Probability of Tephra Accumulation from Cascade Volcanoes



SCENARIO

Glacier Peak or Mount Rainier would erupt with little warning time with a large explosion, sending ash miles into the air, dispersing and then falling in all directions. Although the mudflows would not affect Shoreline, except economically, it would be affected by the ash fall. The tephra would blanket the city, possibly putting stress on power lines and roofs. A heavy rainstorm could occur, creating a heavy clay from the ashfall. Traffic accidents, reduction in production by business, stressed power lines and residential roof collapse may occur. The wet ash would also clog storm drains, causing the secondary hazard of flooding.

The dry tephra would also cause respiratory problems for the elderly and infirm people living in the city, particularity affecting those residing at the CRISTA Ministries Facility and at elderly and retirement centers.

LOSS ESTIMATION

Loss from exposure to volcanoes in Shoreline is difficult to calculate because the loss is related to tephra distribution. Extents of affected areas are also often dependent on weather conditions such as wind and rain. The damage from tephra could range from no loss to property and very little clean up expenditure (a loss estimate very near to $0) to potential in loss of life and expensive emergency response and clean-up

figures ranging from hundreds to thousands of dollars. Given this variety, it is difficult to assess exposure to volcanoes with enough specificity to allow loss estimation.

HAZARDOUS MATERIALS

DEFINITIONS

Extremely Hazardous Substances: A list of substances deemed extremely hazardous under Section 312 of Title III that is the same as the list of substances published in November 1985 by the Administrator in Appendix A of the ''Chemical Emergency Preparedness Program Interim Guidance''. Hazardous Materials: (sometimes referred to as 'hazmat') have chemical, physical, or biological natures that threaten life, health or property when released. There are several properties or qualities that make a material hazardous, including explosivity, flammability, combustibility, corrosiveness, chemical reactivity, toxicity, and radioactivity. Hazardous materials can also exhibit qualities of a biological agent. Tier II Reporter: Under Section 312 of Title III, facilities that store chemicals must provide specific information about the chemicals on site, at any one time, to the State Emergency Response Commission (SERC), Local Emergency Planning Committees (LEPCs), and local fire department. The threshold levels for reporting chemicals stored on site is the threshold planning quantity (TPQ) or 500 pounds at any one time, whichever is less for extremely hazardous substances (EHS); or 10,000 pounds at any one time for hazardous substances.

BACKGROUND

Hazardous materials releases occur through spills, leaks, emissions of toxic vapors, or any other process that enables the material to escape its container and enter the environment. Hazardous material incidents that result in a release can cause significant damage to both humans and the environment. The impact of hazardous materials incidents depends on the quantity and physical properties of the chemical. It depends on the type of release that occurred and its proximity to population and businesses.

In 1986, Congress enacted the Emergency Planning and Community Right-to-Know Act (EPCRA) as part of the Superfund Amendments and Reauthorization Act (SARA) as a result of public concern about hazardous material and chemical accidents. This act, known as Title III, establishes requirements for federal, state, and local governments as well as for industry regarding emergency response planning and the public's right to know about hazardous chemicals in their community. The State of Washington has adopted the Federal Title III law and regulations (WAC Chapter 118-40). Title III requires that all facilities or businesses that have reportable quantities of certain chemicals must complete a Tier II Emergency and Hazardous Chemical Inventory report. Each facility does this for each type of Tier II chemical that is present. This must be given to the LEPCs, the local fire department and the Washington Department of Ecology.

HAZARDOUS MATERIALS IN SHORELINE

The 2009 Plan includes updated inventories of Tier II facilities and accordingly builds on the risk analysis included within the 2004 HMP.

A hazardous materials release can occur from two sources: from fixed sites (facilities that hold hazardous materials on site) and from transportation related operations. Because of the small amount of Tier II reporters and the presence of critical transportation infrastructure, Shoreline is more likely to have transportation related hazardous materials release. Besides Tier II reporters and transportation incidents, areas of concern are the Washington State Public Health Laboratories that is located on the Fircrest campus and gasoline stations. The lab has a fairly sizeable number, but in small quantities, of individual chemicals. The lab is not considered a Tier II reporter because of the small quantity of each chemical it stores. There are 10 gasoline stations located within Shoreline.

TIER II REPORTERS

The City of Shoreline has 8 Tier II facilities as of 2009, which are shown in Table 4-16. Two of the facilities belonged to AT&T Wireless and reported the presence of sulfuric acid. Other facilities include a Metro Transit Bus Base which contained bus related materials such as diesel fuel and antifreeze; a Seattle City Light substation that has sulfuric acid on site; and the Washington Tree service, which has Ammonium Sulfate onsite.

Table 4-16 Tier II Facilities in Shoreline

Facility Name	Address	Type of Chemical
AT & T Kenwood	14515 15th Ave NE, 98155	Sulfuric Acid
AT & T North City	18012 15th Ave NE, 98155	Sulfuric Acid
Home Deport #4707	1335 N. 205th St, 98133	Lead Sulfuric Acid
Jim's Northgate Towing	16510 Aurora Ave N, 98133	Gasoline Motor Oil Diesel Fuel
King County DOT Bruggers Bog Maintenance Facility	19547 25th Ave NE, 98155	Diesel Fuel #2 Gasoline
Metro Transit North Base	2160 N. 163rd St., 98133	Ethyleneglycol Waste Anti-Freeze Diesel Fuel #2 Lube Oil

		Transmission Fluid Gasoline Waste Oil Lacquer Thinner
Richmond Beach Chevron	617 NW Richmond Beach Rd., 98177	Gasoline
Washington Tree Service, Inc	20057 Ballinger Way, NE, 98155	Propane Ferrous Sulphate Potassium Chloride Ammonium Sulfate

TRANSPORTATION

Three major right-of-ways traverse Shoreline and are used to transport hazardous material. These are the BNSF railroad, which is located along the western shore of the city, State Highway 99/ Aurora Avenue, which runs through the middle of the city, and Interstate 5, which is just east of Aurora Avenue. Although it is not known how much or exactly what is being transported through the area, Shoreline has a similar vulnerability as the rest of King County, which has one of the highest probabilities in the state due to the large amounts of industry and port facilities in the area. Recently there has not been any significant railroad accident in King County; however, Pierce County has recently had a railroad derailment, which spilled boric acid and diesel fuel into the Puget Sound[30].

The probability of a hazardous material release in Shoreline is similar to that of King County. Between 1998 and 2001, King County had 352 fixed facility spills and 189 transportation related spills[31].

Hazardous material releases can be divided into three categories. These categories are based on the severity of the incident and the emergency response that is warranted by each[32]. A minor incident can be safely cleaned up and managed by one or two people. An isolated incident is one that only affects a single area but has to be handled by more than two people. An unmanageable incident affects large areas and requires immediate response regardless of the quantity involved in the incident. Hazardous material

[30] KCEM. http://www.metrokc.gov/prepare/docs/RHMPHazmatandRadiation.pdf

[31] Washington State Department of Health (WSDOH). 2003. Office of Environmental Health and Safety. Hazardous Substances Emergency Events Surveillance Program. Hazardous Substance Emergency Events in Shoreline, 1997-2001. October 2003

[32] University of Toledo. http://safety.utoledo.edu/contplan.htm

releases can affect both human and ecological health. The severity depends on the type and amount of chemical released and the effects range from minor to catastrophic.

Hazardous material releases can occur at any time without warning. Once the release has occurred the potentially affected areas will have little or no warning time depending on what chemical was released and the method by which the chemical will travel.

PAST EVENTS

The Hazardous Substances Emergency Events Surveillance (HSEES) program, sponsored by the Agency for Toxic Substance and Disease Registry (ATSDR), tracks emergency releases of non-petroleum hazardous substances. Data from 1993 through 2001 was evaluated on events that have occurred in the City of Shoreline and was provided in a report, which found four recorded events in Shoreline during the past nine years[33].

The first Shoreline HSEES event occurred in 1997 and involved a spill of diazinon with fungicide that was spilled into an open ditch from a spraying truck that had overturned. The driver of the spraying truck experienced minor contusions and was treated at a hospital emergency room and released.

In 1999, a total of three people were treated for respiratory irritation and nausea after they were exposed to a leak of chlorine gas at a swimming pool. Two were taken to an emergency room where they were treated and released. The third person sought treatment from a private doctor. Cause of the leak was unknown. In 2000, a valve snapped on a 300 pound cylinder of trifluorobromomethane (Halon 1301) gas, allowing the entire contents to escape to the atmosphere. There were no injuries from this event, which occurred at a governmental facility loading dock. In 2001 a bus leaked eight gallons of coolant onto a city street. There were no injuries and the spill was cleaned up.

SECONDARY HAZARDS

Hazardous material incidents can produce a variety of secondary effects. Fires resulting from hazardous materials releases are the most significant secondary hazard with potential releases caused by earthquakes. Hazardous material incidents can have a significant effect on the environment. Releases into the environment have the potential to significantly damage soils, water quality, wildlife habitat as well as vegetation. Harm to protected areas and streams, as well as critical habitat for threatened or endangered species is likely. Processes to clean up hazardous material releases are costly and time consuming, resulting in severe environmental and economic impacts. This would most likely occur along the protected shores of Shoreline if a hazardous materials release from a train occurred.

EXPOSURE AND VULNERABILITY

Washington State Department of Health study examined incidents occurring in 1992. According to the report there were 118 events in King County, about 10.2% involving transportation and 89.8% occurring at fixed facilities. Twenty-six incidents caused a total of 66 injuries, most commonly involving acids and volatile organic compounds. Additionally, 29 incidents resulted in the evacuation of nearly 1400 people.

[33] Washington State Department of Health (WSDOH). 2002. Office of Environmental Health and Safety. Hazardous Substances Emergency Events Surveillance Program.

The report indicates that 44 incidents in King County occurred within one-quarter mile of residential areas, indicating some risk to people not directly involved with the released chemicals.47 A recent Washington State Hazard Identification and Vulnerability Analysis cited an average of 960 emergency spills occurring annually in King County[34].

The most vulnerable buildings and populations are those that are located near the Tier II facilities and near the transportation corridors. The Fircrest campus is vulnerable to a release from the Washington State Public Health Laboratories. Vulnerable neighborhoods include the Richmond Beach area, which has the access road leading to Point Wells and the BNSF tracks. The shoreline in this area is also vulnerable.

SCENARIO

A most likely hazardous materials release would be caused by a traffic accident on Aurora Avenue or on Interstate 5. A fire would erupt sending toxic fumes into the air. Hazardous materials would drain off the road and into nearby Thornton Creek destroying the natural environment. Certain materials could be hazardous to the health of nearby residents, especially those downwind from a release. Another scenario, which may have more damaging effects, would be from a release caused by a train derailment from an undetected landslide or track malfunction. This would have an effect on those in the Richmond Beach area, especially if a fire occurs. The natural environment would also be jeopardized as the chemicals could drain into Puget Sound, polluting the water and shoreline. A third scenario is a release from the Tier II facility, train or truck carrying hazardous materials due to an earthquake.

LOSS ESTIMATION

Loss from exposure to hazardous materials in Shoreline is difficult to calculate without the completion of technical studies on each Tier II reporter. Shoreline has a wide array of chemicals, each of which has its own properties and effects when released. Extents of release and affected areas are also often dependent on weather conditions such as wind and rain. Some hazardous materials, when released, would result in no loss to property and very little clean up expenditure (a loss estimate very near to $0), while others would result in loss of life in surrounding neighborhoods, expensive emergency response and clean-up figures ranging from hundreds to thousands of dollars. Given this variety, it is difficult to assess exposure to hazardous material spills with enough specificity to allow loss estimation.

TSUNAMI/SEICHE

DEFINITIONS

Seiche: A seiche is a standing wave in an enclosed or partly enclosed body of water and normally caused by earthquake activity and can affect harbors, bays, lakes, rivers and canals.

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http://www.kingcounty.gov/safety/prepare/EmergencyManagementProfessionals/PlansandPrograms/RegionalHazardMitigationPlan/ApprovedPlan.aspx

Tsunami: Tsunamis are sea waves usually caused by displacement of the ocean floor and are typically generated by seismic or volcanic activity or by underwater landslides.

BACKGROUND

A tsunami consists of a series of high-energy waves that radiate outward like pond ripples from the area in which the generating event occurred. The sequence of tsunami waves arrives at the shore over an extended period. The first wave will be followed by others a few minutes or a few hours later with the following waves generally increasing in size over time. Tsunamis are commonly 60 or more miles from crest to crest and travel at remarkable speeds, often more than 600 miles per hour in the open ocean. They can traverse the entire Pacific Ocean in 20 to 25 hours. These are extremely destructive to life and property. The tsunami caused by the 1883 eruption of Krakatau, caused more than 30,000 fatalities, and the 1886 tsunami on the Sunriku coast of Japan killed about 26,000 people.

Typical signs of a tsunami hazard are earthquakes and/or a sudden and unexpected rise or fall in coastal water. The large waves are often preceded by coastal flooding and a quick recession of the water. Tsunamis are difficult to detect in the open ocean; with waves only one or two feet high. The tsunami's size and speed, as well as the coastal area's form and depth are factors that affect the impact of a tsunami; wave heights of fifty feet are not uncommon. In general, scientists believe it requires an earthquake of at least a magnitude 7 to produce a tsunami.

Seiches are usually earthquake-induced but typically do not occur close to the epicenter of an earthquake, but hundreds of miles away. This is due to the fact that earthquake shock waves close to the epicenter consist of high-frequency vibrations, while those at much greater distances are of lower frequency, which can enhance the rhythmic movement in a body of water. The biggest seiches develop when the period of the ground shaking matches the frequency of oscillation of the waterbody.

TSUNAMI/SEICHE HAZARD IN SHORELINE

The Tsunami risk analysis relied on data included within 2004 HMP.

Tsunamis affecting Washington State may be induced by an earthquake of local origin, or they may be caused by earthquakes at a considerable distance, such as from Alaska or Japan. Shoreline does not have any major lakes within its area, but a severe quake could create seiches in the small ponds such as Ronald Bog and Echo Lake that could potentially cause damage.

The frequency of a tsunami or seiche is related to the frequency of earthquakes and landslides that can produce a tsunami or seiche. There is a low probability of a tsunami or seiche occurring in Shoreline.

It is unlikely that a tsunami or seiche generated by a distant or Cascadia Subduction earthquake would result in much damage in Shoreline. One computer model suggests that a tsunami generated by such an earthquake with a magnitude of 8.5 would only be 0.2 to 0.4 meters in height when it reached the Seattle/Shoreline area. This results from the shielding of the Olympic Peninsula and the Puget Sound islands. However, Puget Sound is vulnerable to tsunamis generated by local crustal earthquakes (such as along the Seattle fault or South Whidbey Island fault) or by submarine landslides triggered by earthquake shaking. This type of tsunami could impact Shoreline. The low-lying areas along the Puget Sound coastline could suffer damage.

Warning vulnerable areas would be nearly impossible due to the close proximity to the origin of the tsunami. The first wave would probably hit coastline areas within minutes.

PAST EVENTS

There is no historic record of tsunamis affecting Shoreline or Puget Sound. However, geologic evidence of tsunamis has been found at Cultus Bay on Whidbey Island and at West Point in Seattle. Researchers believe these tsunamis are evidence of earthquake activity along the Seattle fault.

The area around Shoreline has been affected by seiches, most recently caused by a November 3rd, 2002 when a 7.9 magnitude quake in Alaska shook houseboats loose from their moorings in Lake Union. No damage was reported in Shoreline for this event.

EXPOSURE AND VULNERABILITY

Properties located along Puget Sound may be vulnerable to tsunamis. There are 32 parcels that could be affected and are located on 27th Avenue NW. Properties directly adjacent to ponds or the small lakes in Shoreline may be potentially affected by a seiche caused by a local or distant quake. Echo Lake has development surrounding it, as does Ronald Bog on its south side. Since actual buildings are located a several feet above the lake, the most affected structures would be the piers on Echo Lake and any boats moored to them.

SCENARIO

The worst-case scenario for a tsunami and seiche would be as a secondary effect of a powerful local earthquake on the Seattle fault or South Whidbey fault zones centered in Puget Sound. This would send a tsunami rushing towards Shoreline with little or no warning time, damaging buildings and property located along the low lying coast in the Richmond Beach area. The tsunami itself would damage the closest buildings and the floods from the storm surge would damage other buildings. The seiche from this quake would also damage the small piers located on Echo Lake and some of the boats docked on them causing property losses for households. The seiche could possibly flood some basements of the buildings located near the lake, and the basements of buildings near Ronald Bog.

LOSS ESTIMATION

To calculate the property damage loss estimation for tsunami/seiche, the assessed value, $36,820,000, was multiplied by 13%. The 13% damage estimation value was taken from the FEMA State and Local Mitigation Planning How-to-Guide (FEMA 2001). It was assumed that the houses that would be exposed to a tsunami/seiche are 2 stories with no basements and that the flood level would be 2 feet. This gave a value of $4,786,400. If using the previous assumptions, damage estimates for the contents of the houses could be calculated by multiplying the content value by 19.5%. To calculate the number of people affected, the number of structures on 27th Avenue NW, 32, was multiplied by the average household size in Shoreline, which is 2.5 (Census 2000). This gives a figure of 80 people affected.

CHAPTER 5 RISK RATING AND CAPABILITY ASSESSMENT

In the 2004 Shoreline HMP, risk was defined as the product of the *frequency* of a damaging hazard event times the *impact*. Capabilities were presented in the earlier plan but not factored into the risk assessment. The risk analysis used in this update is a departure from the2004 HMP. The 2009 HMP incorporates a Strengths, Weaknesses, Opportunity and Threat (SWOT) analysis. SWOT Information was gathered at earlier stakeholder meetings. Results were recorded and reviewed and discussed at subsequent meetings.

A SWOT analysis is a strategic planning method used to evaluate the Strengths, Weaknesses, Opportunities, and Threats involved in a project or in a business venture. It involves specifying the objective of the business venture or project and identifying the internal and external factors that are favorable and unfavorable to achieving that objective. This method was used in the development of the Shoreline HMP because of its wide acceptance and familiarity.

RISK RATING & CAPABILITY ASSESEMENT

SWOT analyses allowed for extensive stakeholder input. Stakeholder input was particularly important with this update in that the Plan was done between census years and sufficient amounts of new data were not as readily available. The SWOT analyses incorporated anecdotal information that was used to supplement existing data, where possible.

This SWOT analyses was used to determine the Strengths, Weaknesses, Opportunities, and Threats involved in achieving the following goals.[35]

1. Protect public health, welfare, and public safety
2. Minimize losses to existing and future properties
3. Encourage coordination and communication amongst public and private organizations
4. Ensure continuity of critical facilities and corresponding operations of local government
5. Protect and enhance environmental quality

This analysis helped create the strategies and action items offered in this plan by answering each of the following four questions, many times:

1. How can Shoreline Use and Capitalize on each Strength?
2. How can Shoreline Improve each Weakness?

[35] The technique is credited to Albert Humphrey, who led a research project at Stanford University in the 1960s and 1970s using data from Fortune 500 companies.

3. How can Shoreline Exploit and Benefit from each Opportunity?

4. How can Shoreline Mitigate each Threat?

Putting SWOT analyses within the context of the more traditional risk analysis, *Threats* can be thought of as *Hazards*, *Weaknesses* as *impacts, exposures or vulnerabilities*, and *Opportunities* and *Strengths* as *Capabilities*. Risks are a function of Threats, Weaknesses, and Opportunities and Strengths.

The HMP's objective is to reduce risks by mitigating external threats through reducing internal weaknesses, exploit external opportunities and by capitalizing on internal strengths.

HAZARDS RANKING

The Emergency Management Council (EMC) ranked hazards as to their importance. This ranking intuitively includes an assessment of effect on the community and the capabilities available to reduce risk. The EMC was most concerned about Earthquakes, Severe Weather including Climate Change and flooding/stormwater. They were less concerned with Wildland Fire, Volcano—ash, Hazardous Materials Landslides/Sinkholes and Tsunami.

When the planning team separated the risk elements and assigned relative ratings provided by stakeholders, a very similar ranking resulted. The risk ranking described below was driven by the hazards/external threats cited as important by the Emergency Management Council and Neighborhood Association. Similar to the 2004 HMP, rankings of 1 -3 were assigned to each hazard as to the chance of generating a damaging event (see Table 5-1).

- High - Hazard event is likely to occur within 25 years (Numerical value 3)
- Medium – Hazard event is likely to occur within 50 years (Numerical value 2)
- Low – Hazard event in not likely to occur within 50 years (Numerical value 1)

Table 5-1 Hazards Ranking

Hazard	Hazard Ranking	
Flooding/stormwater	High	3
Severe Weather and Climate Change	High	3
Earthquakes	Medium	2
Landslides/Sinkholes	Medium	2
Wildland Fire	Medium	2
Hazardous Materials	High	1
Tsunami	Low	1
Volcano—ash	Low	1

IMPACT

Also as with the 2004 Shoreline HMP the impacts of each hazard were divided into three broad categories; impacts to people, impacts in dollar loss and impacts to the environment. All estimates

include impacts directly to residents of Shoreline as well as to larger systems. Impacts to the environment were estimated in the update, but were not included within the 2004 Shoreline HMP.

These three categories were also assigned weighted values. Impact to people was given a weighted factor of 3 and impact of dollar losses and the environment were given a weighted factor of 2. And as not to weight impacts greater than the weight given to the hazard, the sum of the weighted impacts scores was divided by the number of variables or 7 (see Table 5-1).

For impact to people the categories were broken down as follows:

- High - Hazard event seriously affects greater than 100 people (Numerical value 3)
- Medium – Hazard event seriously affects 26-100 people (Numerical value 2)
- Low – Hazard event seriously affects 0-25 people (Numerical value 1)

For the impact in dollar loss, it was estimated what the dollar loss would be from a major event of each hazard. For impact in dollar loss, the categories were broken down as follows:

- High - Hazard event causing damages over $10 million (Numerical value 3)
- Medium – Hazard event causing damages between $1 and $10 million (Numerical value 2)
- Low – Hazard event causing damages less than $1 million (Numerical value 1)

For the impact to the larger environment it was estimated that:

- High - Hazard event causing the potential for irreversible damage – damage where degradation is so severe recovery cannot be exacted to occur naturally.. (Numerical value 3)
- Medium – Hazard event causing damages, the effects of which could be mitigated over the long term. (Numerical value 2)
- Low – Hazard event causing damages, the effects of which could be mitigated over the short term. (Numerical value 1)

Table 5-2 Impact Ranking

Risk Ranking				
Hazard	Impact Ranking			
	People (*3)	Dollars (*2)	Env. (*2)	Total (Sum/7)
Flooding/stormwater	3	2	3	2.7
Severe Weather and Climate Change	3	2	3	2.7
Earthquakes	3	3	3	3.0
Landslides/Sinkholes	2	2	2	2.0
Wildland Fire	2	2	2	2.0
Volcano-- ash	3	2	2	2.4
Hazardous Materials	2	2	3	2.3
Tsunami	2	2	2	2.0

RISK RATING

The risk rating for each hazard was determined by multiplying the assigned numerical value for probability to the weighted numerical value of impacts (see Table 5-3).

Table 5-3 Risk Ranking Total

Risk Ranking			
Hazard	Hazard Ranking	Impact Ranking Total (Sum/7)	Risk Ranking Total
Flooding/stormwater	3	2.7	2.9
Severe Weather and Climate Change	3	2.7	2.9
Earthquakes	2	3.0	2.5
Landslides/Sinkholes	2	2.0	2.0
Wildland Fire	2	2.0	2.0
Volcano-- ash	1	2.4	1.7
Hazardous Materials	1	2.3	1.6
Tsunami	1	2.0	1.5

The risk ratings were developed to help focus the mitigation strategies to areas that warrant greatest attention. The hazards were given an overall risk rating which ranked them in relation to one another.

The highest risk ratings in 2009 were similar to those developed 5 years earlier with high ranking going to Flooding/stormwater, Severe Weather / Climate Change, and Earthquakes.

CAPABILITIES

The hazards mitigation planning team asked a wide range of Shoreline stakeholders to state what they thought were the strengths and weaknesses of Shoreline individuals and organizations. They were also

asked what threats created the greatest concern and what opportunities were present. These questions were asked of the Shoreline Emergency Management Council, Fire Commissioners, Association of Neighborhoods representatives, individual department employees and those responding to an on line survey.

In documenting stakeholder answers, the mitigation team checked inconsistencies with responding individuals, and where possible, responses were corroborated with available data. Unique items without support from at least one additional respondent were discarded.

The responses are listed below. Items are offered to identify capabilities, mitigation action items and methods supporting implementation. They do not represent Department or non City agency policy.

STRENGTHS

Strengths are internal to the City in general and represent items to build upon. Strengths can be grouped into four categories:

1. Monitoring Hazards & Communicating Risk
2. Socio-Physical strengths
3. Sharing Risk
4. Disaster Prevention (Preparedness and Mitigation)

Monitoring hazards and communicating risk strengthens were thought attributable to (a):

1. Solid and active Association of Neighborhoods and Community Emergency Response Team, (CERT).
2. Responsive Chamber of Commerce.
3. The Fire Department volunteer radio team.
4. The operational capabilities of the New Civic Center (to be completed in the fall of 2009) and newer Fire Department building both of which are seismically safer facilities and assure functionality during and following significant seismic events.

Socio-physical strengths offered included:

1. In a large part, that much of the city has been built on soils that do not intensify ground shaking during earthquakes. (NEHRP A, B and D soils).
2. Shoreline's Interurban trail system that connects communities and provides alternative access during winter storms and could be extremely beneficial following significant earthquakes.
3. School facilities that are well distributed throughout all neighborhoods and could provide walkable places of refuge.

4. Changes in density and land use providing opportunities as single family homes are replaced with multi family structures and adult care facilities. New development will trigger:

- Seismic upgrades/compliance
- Onsite detention/retention
- A dense road systems assuring internal and external connectivity.

Sharing Risk has been accomplished chiefly through partnering with other agencies, neighborhood organizations, residents and workers.

1. Shoreline has partnered with other service providers through franchise agreements. Several of these agreements are coming up for renewal and all existing agreements allow the City to participating in decision making.
2. The City is home to several large stores. Their larger inventories could help reduce supply side vulnerabilities immediately following regional events.
3. The city has adopted the Washington Department of Ecology Low Impact Development Code. This should reduce localized storm water flooding and increase the quality of water entering Puget Sound.
4. Christa facilities have partnered with neighboring organizations to increase functional redundancy.

Disaster prevention measures have been instituted or exploited by (in):

1. Responding to electrical power dependencies, Shoreline has:

- Provided back up generation to key facilities (Police and Fire Department, Spartan Recreation Center [City Shelter] and planned for the new City Hall)
- The City has instituted uninterruptible power supply (UPS) technology adding to the robustness of the traffic systems

2. Older infrastructures are being replaced, retrofitted, and upgraded.
3. Inventorying and replacing older buried utilizes.
4. Adopting and enforcing the International Building Code (IBC).
5. The new Civic Center and newer Fire Department being seismically resilient and having alternative power and should be functional during and following extreme events.
6. All but a few Western slope communities being connected through numerous walkable shelter opportunities throughout the City.
7. City Building Department training seismic retrofitting contractors.
8. Ridge Crest community approving a green street retrofit pilot project.

WEAKNESSES

Weaknesses are shortcomings internal to the City in general and represent items to overcome. Weaknesses were grouped into four categories:

1. Monitoring Hazards & Communicating Risk
2. Socio-Physical weaknesses
3. Assuming Risk
4. Disaster Prevention (Preparedness and Mitigation)

Monitoring and communication shortfalls most often mentioned involved

1. City Departments having difficulty in communicating with an increasing number of non-English speaking residents and workers
2. The current small Emergency Operating Center (EOC)

Socio-Physical weaknesses within Shoreline that result in stressing the communities ability to provide support (to an):

1. Increasingly aging populations living in isolated housing dispersed throughout the community.
2. Increasing number of adult care facilities and group homes.
3. Increasing number of non-English speaking residents and service workers at care facilities, and a significant number of Department staff living outside of the City.
4. Staff resistance in planning for possible disasters
5. Somewhat isolated and forgotten Shoreline Community College (SCC) campus.– densely surrounded w/ trees.(Vulnerable population with 5000+)
6. Four schools within one mile of Public Health Lab.

Disaster Vulnerabilities stressing the City's ability to provide adequate services include:

1. Older infrastructures including water, sewer and electricity.

- Reoccurring losses of electrical power particularly significant to IT systems.
- Knowledge of where buried infrastructure is located is not comprehensive -- water, sewer and electric.
- Three Seattle City Light owned and operated transformers that are over 50 years old and for which parts are not readily available.
- Frequent loss of power within central Shoreline. (between 175th and 205th)
- Frequent gas leaks.

2. Police Department facilities located in undersized older un-seismically retrofitted building.
3. Community shelters not seismically sound and lacking alternative power.
4. Older school facilities that have not been seismically retrofitted.

Assuming risks by not:

1. Partnering with others including Shoreline residents, faith-based groups, neighborhood organizations and commercial interests is limited.
2. Owning heavy equipment knowing that the competition for outside sources would be severe and mostly unavailable during regional scale incidents such as an earthquake or severe winter storm.
3. Having all communities be designated "Ready Neighborhoods" – prepared to help one another.
4. Having many individuals prepared, particularly for frequent power outages.

OPPORTUNITIES

Opportunities are external to the City in general and represent items to exploit or enhance. Opportunities can be grouped into four categories:

1. Natural &environmental opportunities (e.g. resources, buffer zones)
2. Built environment
3. Business & economic
4. Human & social capacity

Natural and built environmental opportunities are available (to):

1. All neighborhoods, with the exception of the Apple Tree Lane community, that are not directly exposed to Puget Sound hazards (Tsunamis, coastal storms…) The Burlington Rail Road has assumed responsibly for many coastal risks.
2. All but a few pockets of soft soil areas (NEHRP D - F) within the larger Shoreline built environment.
3. Those that can take advantage of preparedness expertise and shelter opportunities available because of Shoreline Community College.
4. Because of a redundant electrical grid.
5. Residents benefiting from reduced North / South isolation with improvements to I-5 / Aurora Avenue.
6. City residents in having beach access strengthening the City's sense of place.

7. Walkable community and urban trail emphases within the City Comprehensive Plan and visioning initiatives.

8. Implementation of Seattle Project Impact home retrofitting program.

Business and economic opportunities exist because of (the):

1. Proximity of Shoreline to Northern and Southern regional markets.

2. A growing population providing a larger tax base.

Human and social capacity to share risks appears strong because of (an active):

1. Chamber of Commerce and designated Economic Development Manager.

2. Association of Neighborhoods and promotion of "Neighborhood Ready" initiative.

3. Adopting and enforcement of the International Building Code, Low Impact Development Manual.

4. Adopting the Project Impact Home Retrofit Program.

THREATS

Threats are external and generally outside of the City's control. They represent items for which their impacts are to be minimized. Threats will be discussed within the context of each hazard. Hazards will be profiled, vulnerabilities described and impacts to the Department's capabilities presented.

1. Natural &environmental threats

2. Built environment

3. Business & economic

4. Human & social capacity

Natural &environmental threats include:

1. Western communities' environments are subject to erosion, wildland fires.

2. Increased likelihood of West / East isolation resulting from Puget Sound to the West and lake and mountains to the far East.

3. Vulnerable areas. Where much of the City's built infrastructure is located on stronger soils (NEHRP A-C), compacted by continental glaciers reducing the vulnerability of ground shaking, compacted soils drain poorly contributing to drainage problems and stormwater flooding. Isolated areas where rivers have sliced through compacted impermeable soils thereby result lands vulnerable to erosion and increased ground shaking during earthquakes.

Built environment threats include:

1. Isolation of City residents and business districts – lack of (reduced) access and entrance/egress. Dependence on I-5 and Aurora for North South access. West access is blocked by Puget Sound and to the east access by I-5 and a limit extent Aurora Boulevard.

2. Water tower on 145th near St. Dunstan Church. (Water towers near Christa Ministries campus may collapse.)

3. Vulnerabilities as stated by Shoreline Police to:

- Christa Ministries care facilities because of its open campus.
- Crime resulting from major North / South surface corridors. (I-5 and Aurora)
- State Laboratory being an attractive target for mischief.
- Burlington Northern Railroad facilities and Point Wells because of isolation.
- Scattered isolated parks.

Business & economic thread result from:

1. A significant Regional event such as an Earthquake or Winterstorm that limits access along I-5 or Aurora could prevent goods and services from reaching Shoreline business.

2. Global economy could get much worse

Human & social capacity threats increased by

1. Isolated populations that are vulnerable in and of themselves but also could cause adverse impacts to emergency rescue workers.

2. Pandemic vulnerability because of increase in non English speaking residents and increases in foreign contacts.

CHAPTER 6 PLAN GOALS AND OBJECTIVES

This chapter defines the outcomes that can be expected as a result of successful implementation of this plan. Plan goals are broad statements describing the principles that guide the actions suggested in this document. The Emergency Management Council determined that the goals used to drive the 2004 Hazards Mitigation plan did not need amending and were approved for the 2009 HMP Update. These goals i were designed to support those defined in other adopted plans for the City of Shoreline.

Plan objectives are more targeted statements that define strategies and implementation steps to attain the goals. Specific mitigation actions are defined in Chapter 7, and describe how the goals and objectives outlined here should be implemented.

GOAL 1: PROTECT PUBLIC HEALTH, WELFARE, AND PUBLIC SAFETY

There is no more important goal for this hazard mitigation plan than to protect the people who live in Shoreline, their homes, their businesses and the infrastructure that serves them. Since individuals must undertake many forms of mitigation in their homes, it is crucial that the general public be made aware of the findings in the risk assessment in this document. Increasing public knowledge of potential hazards can save lives and property.

OBJECTIVE 1.1: INCREASE PUBLIC AWARENESS OF HAZARDS

OBJECTIVE 1.2: ENCOURAGE INVOLVMENT OF COMMUNITY IN RISK REDUCTION PROGRAMS

GOAL 2: MINIMIZE LOSSES TO EXISTING AND FUTURE PROPERTIES

It is important to implement mitigation measures that will minimize loss to existing properties as well as mitigate the development that is going to happen in the future. Programs and initiatives can be critical in successfully mitigating against hazards.

OBJECTIVE 2.1: SUPPORT PROGRAMS AND INITIATIVES TO REDUCE RISK TO PROPERTY AND THE SURROUNDING ENVIRONMENT

OBJECTIVE 2.2: SUPPORT PROGRAMS AND INITIATIVES TO REDUCE RISK IN RESIDENTIAL, COMMERCIAL, AND GOVERNMENTAL STRUCTURES, ESPECIALLY THOSE PRONE TO HAZARDS

OBJECTIVE 2.3: SUPPORT UPGRADES TO CRITICAL INFRASTRUCTURE AND FACILITIES

GOAL 3: ENCOURAGE COORDINATION AND COMMUNICATION AMONGST PUBLIC AND PRIVATE ORGANIZATION

When there is coordination and communication amongst public and private organizations on emergency preparedness, response, recovery and mitigation measures it will allow these groups to work efficiently together to ensure risks and impacts from a disaster event are reduced.

OBJECTIVE 3.1: ENCOURAGE ORGANIZATIONS, BUSINESSES, AND LOCAL GOVERNMENTAL AGENCIES WITHIN COMMUNITY AND REGION TO DEVELOP PARTNERSHIPS

OBJECTIVE 3.2: PROMOTE CONSISTENCIES IN COMMUNICATION, PLANS AND POLICIES TO FACILITATE COORDINATION BETWEEN ALL INVOLVED GROUPS

GOAL 4: ENSURE CONTINUITY OF CRITICAL FACILITIES AND CORRESPONDING OPERATIONS OF LOCAL GOVERNMENT

During and after a disaster it is important the critical facilities and corresponding operations of local government are properly functioning so that the City can adequately respond to the event.

OBJECTIVE 4.1: SUPPORT REDUNDANCY OF CRITICAL GOVERNMENT FUNCTIONS

OBJECTIVE 4.2: PROMOTE USE OF NEW TECHNOLOGY IN CRITICAL OPERATIONS

GOAL 5: PROTECT AND ENHANCE ENVIRONMENTAL QUALITY

Healthy natural systems are important to this plan for several reasons. First, when ecosystems are healthy, they can provide protection from natural hazards. Second, natural systems can also be damaged through disasters. Toxic materials releases and sediment loading from landslides or flooding can damage the ecosystems that are important to the quality of life for Shoreline residents.

OBJECTIVE 5.1: ENCOURAGE LOW IMPACT DEVELOPMENT

CHAPTER 7 MITIGATION AND IMPLEMENTATION

This section describes an action plan to reduce risk and loss from future hazard events in the City of Shoreline. The specific projects are listed in the pages that follow. Mitigation strategies were defined and prioritized primarily through a formalized workshop process with stakeholder committee members. This prioritization was based on a benefit cost review for each mitigation strategy and importance to the life and safety of the Shoreline community. The planning team verified the results of this process through interviews with knowledgeable local officials and technicians. The Action Items include within this update contain Items that new and updated from the 2004 HMP.

A benefit cost review was conducted for all mitigation strategies, where possible. The review looked at each mitigation strategy and the type and frequency of hazard event the strategy addresses. Avoided damages or benefits of the mitigation strategy estimated based on the primary hazard events the strategy addressed. The avoided damages were annualized based on the event frequency and the net present value was determined by using a 30-year project lifetime and a discount rate of 7% as designated by the FEMA Benefit Cost Analysis Workshop. The estimated costs of each project were determined.

Based on this a benefit cost ratio was calculated. It is important to note that this benefit cost review is only a general estimate of the benefit cost ratio. The benefit cost review was presented to the technical stakeholder committee to understand how the mitigation projects would benefit the community in relation to their corresponding costs. As stated earlier, these items were considered when determining what mitigation projects were most important for the community. The benefits and costs for each mitigation strategy were discussed and the committee was able to prioritize the mitigation strategies most beneficial in reducing risk to the community. Please refer to Section 3 for a description of the dot exercise process used for the planning meeting on June 12, 2009.

In the future, for mitigation projects it may be necessary to complete a more in-depth FEMA approved Benefit Cost Analysis during the project development process. A benefit cost review and corresponding benefit cost ratio for each mitigation strategy are provided. The mitigation strategies are listed below in order of priority. It is also important to note that some of the mitigation strategies suggested below are more accurately defined as response and recovery actions rather than pure mitigation. These items convey recommendations that support the goals and objectives of this plan and are crucial to the life safety of Shoreline residents. These recovery and response items are designated as such in the strategies below. At this time, alternative strategies that would be purely mitigation

Mitigation Strategy Requirements

Requirement §201.6(c)(3): A mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools. This section **shall** include:

(i) A description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.
(ii) A section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.
(iii) An action plan describing how the actions identified in paragraph (c)(2)(ii) of this section will be prioritized, implemented, and administered by the local jurisdiction. Prioritization **shall** include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.
(iv) For multi-jurisdictional plans, there **must** be identifiable action items specific to the jurisdiction requesting FEMA approval or credit of the plan. to the jurisdiction requesting FEMA approval or credit of the plan.

cannot be recommended because they are not cost beneficial. Mitigation grant funds may not be available for response or recovery items, but they are, nonetheless, important in achieving the overall objectives of this plan.

THE MITIGATION PLANNING PROCESS RESULTED IN SEVEN ACTION ITEMS. THESE ITEMS ARE DESCRIBED BELOW AS TO THEIR:

1. Ability to reduction in risk
2. Ranking by the Shoreline Emergency Management Council (EMC) at their June 12, 2009 meeting and by the Community Emergency Response Team (CERT) June 10, 2009 meeting. Both meetings were advertised and both open to the public.
3. The Mitigation goals established by the Emergency Management Council:
    - Protect public health, welfare, and public safety
    - Minimize losses to existing and future properties
    - Encourage coordination and communication amongst public and private organizations
    - Ensure continuity of critical facilities and corresponding operations of local government
    - Protect and promote environmental quality
4. Source of funding
5. Generalized relationship of benefits to costs where by:
    a. Benefits include: the savings in future expected damage, life of the benefit and frequency of future events:
        - Low = Implementation would reduce some loss in expected future damage. The hazard has a low probability of occurrence, but would effect a significant population, or a higher change of occurring, but would affect only a small segment of the City's population. (May save lives, protects property and environmental < 1 M)
        - Medium = Implementation would greatly reduce future expected losses. The hazard it mitigates has a medium probability of occurrence and / or can potentially effect a significant Shoreline population. Or, it reduces the effects of frequent damaging events for a select population. (May save lives, protects property and environment damage < 10 M, > 1M)
        - High = Implementation of this mitigation item is crucial to the long-term safety of all Shoreline stakeholders. It mitigates hazards with a high or medium probability of occurrence and has the potential to affect a great number of people. (Would saves lives and/or > $10 M in property / environmental damages)
    b. Costs estimated at:
        - Low = Existing budget
        - Medium < 1 million in additional funds

- High > 1 million in additional funds

c. Ratios where by

- Low = < 1
- Medium = > 1 and < 2
- High > 2

6. Provided in a table for each action item:

- Whether the item address the two most probable disaster scenario facing the City
  - Isolation of neighborhoods and/or as a City from adjacent areas because of regional scale incidents including severe winter storms or earthquakes.
  - Temporary interruptions from landslides, flooding wildland fires…
- Responsible agencies
- Being new, revised or update from the previous Mitigation Plan
- Being able to be implemented over the short term(< 2 years), (> 2 years) are ongoing
- Hazards addressed by Action Item

ACTION ITEMS

1. TARGET HIGHER RISK NEIGHBORHOODS FOR SPECIFIC RISK REDUCTION MEASURES

RISK: Risks cluster in a few areas. Shoreline is fortunate to be developed largely with earthquake resistant light single story wood frame structures built on soils consolidated by past glaciers. However these areas subject to increased ground shaking, also have a higher risk from other hazards including liquefaction, tsunamis, landslides, wildland fire and in isolation during severe winter storms and large earthquakes.

ACTION ITEMS: Develop a targeted outreach effort to select high risk communities delivered through the Community Services Division with the Emergency Management Coordinator as the lead and collaboration with other departments indicated. Expand and utilize the Map Your Neighborhood program in all communities. These efforts will make use of the ATC and All-hazards Trained Staff in Action Item 2. Below are the list of high risk communities in Shoreline that risk reduction measures will be focused on>

- Ballinger Way and Brugger's Bog communities
- Apple Tree Lane
- Highlands
- Innis Arden/Richmond Beach

- Ronald Bog
- Littles Creek area.

RANKING BY EMERGENCY MANAGEMENT COUNCIL (EMC) AND COMMUNITY RESPONSE TEAM (CERT): The EMC and CERT ranked this item 2 and 3 respectively.

MITIGATION PLAN GOALS MET BY ACTION ITEM:

- Protect public health, welfare, and public safety
- Minimize losses to existing and future properties
- Encourage coordination and communication amongst public and private organizations
- Ensure continuity of critical facilities and corresponding operations of local government
- Protect and promote environmental quality

FUNDING: Shoreline Operating Budget

BENEFIT / COST RELATIONSHIPS: Medium - High

1. Project Benefits: Medium – High

   - Medium = Implementation would greatly reduce future expected losses. The hazard it mitigates has a medium probability of occurrence and / or can potentially effect a significant Shoreline population. Or, it reduces the effects of frequent damaging events for a select population.
   - High = Implementation of this mitigation strategy is crucial to the long-term safety of all Shoreline stakeholders. It mitigates hazards with a high or medium probability of occurrence and has the potential to affect a great number of people.

2. Project Costs: Low - High

1. TARGET HIGHER RISK NEIGHBORHOODS FOR SPECIFIC RISK REDUCTION MEASURES																										
Scenario		**Responsible Org. (Lead "L") &** Partner **Orgs (*)**												**Status**		**Timing**			**Associated Hazards**							
		Fire																								
Isolation	Temporary interruptions	Fire -- Operations	Fire -- Education	Public Works Director	Emergency Management Coordinator	Neighborhood Programs Coordinator	Police Chief	Pl. and Dev. Services Director	Communications Specialist	Parks and Rec. Dept.	Economic Dev. Manager	City Manager	New Item	Updated Item	Short term	Long term	Ongoing	Earthquakes	Hazardous Materials	Severe Weather	Landslides & Sinkholes	Flooding	Wildland Fire	Volcano	Tsunami/Seiche
*	*	*	*	L	L	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		*

TARGET NEIGHBORHOOD ACTION ITEMS:

A. BALLINGER WAY AND BRUGGER'S BOG COMMUNITIES

RISK: Community includes older high occupancy rental dwellings located on soft and liquefiable soils.

ACTION ITEM: Work with apartment managers at regular intervals (5 years) in reaching tenants. Provide opportunities to learn the skills needed by renters living in structures potentially vulnerable to earthquakes.

RANKING BY EMERGENCY MANAGEMENT COUNCIL (EMC) AND COMMUNITY RESPONSE TEAM (CERT): Both the EMC and CERT ranked this sub item number 1.

MITIGATION PLAN GOALS MET BY ACTION ITEM: Protect health, welfare and public safety

FUNDING: Shoreline Operating Budget

BENEFIT / COST RELATIONSHIPS: Medium

1. Project Benefit – Medium.

    - Implementation would greatly reduce future expected losses. The hazard it mitigates has a medium probability of occurrence. It reduces the effects of frequent damaging events for a select although highly vulnerable population.

2. Project Cost – Low (it can be implemented with existing capabilities)

1. TARGET HIGHER RISK NEIGHBORHOODS FOR SPECIFIC RISK REDUCTION MEASURES - Ballinger Way																										
Scenario		Responsible Org. (Lead "L")												Status		Timing			Associated Hazards							
		Fire																								
Isolation	Temporary interruptions	Fire -- Operations	Fire -- Education	Public Works Director	Emergency Management Coordinator	Neighborhood Programs Coordinator	Police Chief	Pl. and Dev. Services Director	Communications Specialist	Parks and Rec. Dept.	Economic Dev. Manager	City Manager	New Item	Updated Item	Short term	Long term	Ongoing	Earthquakes	Hazardous Materials	Severe Weather	Landslides & Sinkholes	Flooding	Wildland Fire	Volcano	Tsunami/Seiche
*	*		*		L	*	*							*			*	*		*					

B. APPLE TREE LANE

RISK: Community was developed before existing National Flood Insurance Program and International Building Codes. Structues, located on soft liquefiable soils threatened by earthquakes, high surf, Cascadia Subduction Zone and locally generated tsunamis, and projected rises in sea level. Community is accessible by a single older bridge and could easily be isolated.

ACTION ITEMS:

- Support home retrofitting alternatives taking advantage of City's contract list of trainer construction companies who are qualified to do structural Retrofitting Program. (elevation and seismic retrofit)

- Introduce discussion with context of Richmond Beach "Map Your Neighborhood Program" through Richmond Beach Neighborhood Association.
- Promote use of NOAA weather radios.

RANKING BY EMERGENCY MANAGEMENT COUNCIL (EMC) AND COMMUNITY RESPONSE TEAM (CERT): The EMC and CERT ranked this sub item 3 and 4 respectively.

MITIGATION PLAN GOALS MET BY ACTION ITEM:

- Protect public health, welfare, and public safety
- Minimize losses to existing and future properties
- Encourage coordination and communication amongst public and private organizations

FUNDING: Shoreline Operating Budget

BENEFIT / COST RELATIONSHIP: High

1. Project Benefit – High
   - Implementation of this mitigation item is crucial to the long-term life safety of the Apple Tree Lane residents. It mitigates hazards with a high or medium probability of occurrence and has a high potential of saving lives.
2. Project cost – Low cost. (Retrofitting/replacing the 196th Street Bridge is listed under Action Item 7)

1. TARGET HIGHER RISK NEIGHBORHOODS FOR SPECIFIC RISK REDUCTION MEASURES - Apple Tree Lane																												
Scenario		Responsible Org. (Lead "L")												Status		Timing			Associated Hazards									
		Fire																										
Isolation	Temporary interruptions	Fire -- Operations	Fire -- Education	Public Works Director	Emergency Management Coordinator	Neighborhood Programs Coordinator	Police Chief	Pl. and Dev. Services Director	Communications Specialist	Parks and Rec. Dept.	Economic Dev. Manager	City Manager	New Item	Updated Item	Short term	Long term	Ongoing	Earthquakes	Hazardous Materials	Severe Weather	Landslides & Sinkholes	Flooding	Wildland Fire	Volcano	Tsunami/Seiche
*	*	*	*	L	L	*		*		*			*		*	*		*		*		*			

C. HIGHLANDS

RISK: Gated community with self imposed access limitations threatened with isolation resulting from earthquakes and severe winter storms. Many homes are subject to land slide risks. Community heavily forested increasingly vulnerable to Wildland fires as the climate warms and summers become dryer.

ACTION ITEM: Include Highland Community in community outreach efforts. Identify contacts with in community and meet with community to discuss neighborhood vulnerability.

RANKING BY EMERGENCY MANAGEMENT COUNCIL (EMC) AND COMMUNITY RESPONSE TEAM (CERT:) The EMC and CERT ranked this sub item 4 and 5 respectively.

MITIGATION PLAN GOALS MET BY ACTION ITEM: Encourage coordination and communication amongst public and private organizations

FUNDING: Shoreline Operating Budget

BENEFIT / COST RELATIONSHIP: High (inexpensive action item with the position of having a great benefit)

1. Project Benefit: Medium

   - Implementation would greatly reduce future expected losses. The hazard it mitigates has a medium probability of occurrence and can potentially effect a significant Shoreline population. Implementation of the action item would reduce the effects of frequent damaging events for the Highline population.

2. Project Cost: Low (Can be addressed with existing budget)

1. TARGET HIGHER RISK NEIGHBORHOODS FOR SPECIFIC RISK REDUCTION MEASURES - Highlands																										
Scenario		Responsible Org. (Lead "L")												Status		Timing			Associated Hazards							
		Fire																								
Isolation	Temporary interruptions	Fire -- Operations	Fire -- Education	Public Works Director	Emergency Management Coordinator	Neighborhood Programs Coordinator	Police Chief	Pl. and Dev. Services Director	Communications Specialist	Parks and Rec. Dept.	Economic Dev. Manager	City Manager	New Item	Updated Item	Short term	Long term	Ongoing	Earthquakes	Hazardous Materials	Severe Weather	Landslides & Sinkholes	Flooding	Wildland Fire	Volcano	Tsunami/Seiche
*			*		L	*							*				*	*		*	*		*		

D. INNIS ARDEN/ RICHMOND BEACH

RISKS: Homes along shore are subject to landslides, liquefaction and intensified ground shaking. Residents could be easily isolated following a damaging earthquake or severe winter storm. About 12 residential structures along creek are shown as being located within the FEMA designated Flood Hazard Area. Through the use of detail maps (LIDAR) and from site inspection these structure to not appear to be floodprone.

ACTION ITEMS:

- Inform owners of floodprone structures of the possibility of revising the FEMA floodplain designation.
- For owners of homes on softer soils encourage implementing non structural and structural retrofitting alternatives. Advise of Shoreline home retrofitting program.

- Advise owners of homes on liquefiable soils of associated vulnerabilities.
- Discussion could be introduced within the context of "Map Your Neighborhood Program" and could take advantage of Seismic Safety Cadre and All hazards Pool.
- Examine City trails programs for alternative access opportunities.

RANKING BY EMERGENCY MANAGEMENT COUNCIL (EMC) AND COMMUNITY RESPONSE TEAM (CERT): Both the EMC and CERT ranked this sub item 2.

MITIGATION PLAN GOALS MET BY ACTION ITEM:

- Protect public health, welfare, and public safety
- Minimize losses to existing and future properties
- Encourage coordination and communication amongst public and private organizations
- Ensure continuity of critical facilities and corresponding operations of local government
- Protect and Protect and promote environmental quality.

FUNDING: Shoreline Operating Budget

BENEFIT / COST RELATIONSHIP: High (inexpensive action item with the potential of having great benefits)

1. Project Benefit: High
   - Implementation of this mitigation item is crucial to the long-term safety of all Shoreline stakeholders. It mitigates hazards with a high or medium probability of occurrence and has the potential to affect a great number of people.
2. Project Cost: Low within the City operating budget

1. TARGET HIGHER RISK NEIGHBORHOODS FOR SPECIFIC RISK REDUCTION MEASURES - Innis Arden																											
Scenario		Responsible Org. (Lead "L")												Status		Timing			Associated Hazards								
		Fire																									
Isolation	Temporary interruptions	Fire -- Operations	Fire -- Education	Public Works Director	Emergency Management Coordinator	Neighborhood Programs Coordinator	Police Chief	Pl. and Dev. Services Director	Communications Specialist	Parks and Rec. Dept.	Economic Dev. Manager	City Manager	New Item	Updated Item	Short term	Long term	Ongoing	Earthquakes	Hazardous Materials	Severe Weather	Landslides & Sinkholes	Flooding	Wildland Fire	Volcano	Tsunami/Seiche
*	*	*	*	*	L	*		*		*			*		*		*	*		*	*	*	*		

E. RONALD BOG

RISK: The residents of the Ronald Bog area of the Meridian Park Neighborhood have experienced property damage during very large rain events. In particular, this area has flooded four times in the recent past: January 18, 1968, January 1, 1997, October 20, 2003, and December 3, 2007. The City is committed to working with these residents to mitigate the damages they suffer and has hosted meetings with the residents and FEMA to inform the residents of FEMA insurance requirements. The City has completed installation of an early warning system that shows the current bog level. This information can be accessed on the City website by the public and staff, and can also be monitored by staff via an automated message system. When the water elevation in bog reaches a certain elevation, City Staff are notified and can initiate a Reverse 911 through the Shoreline Fire Department to the residents of the neighborhood.

ACTION ITEMS:

- Promote the purchase of Flood Insurance
- Meeting with residents in Fall 2009 to discuss Interim Flood Management Plan.
- Promote house hold risk reduction measures.

RANKING BY EMERGENCY MANAGEMENT COUNCIL (EMC) AND COMMUNITY RESPONSE TEAM (CERT): Both the EMC and CERT ranked this sub item 3.

MITIGATION PLAN GOALS MET BY ACTION ITEM:

- Protect public health, welfare, and public safety
- Minimize losses to existing and future properties

FUNDING: Shoreline Operating Budget

BENEFIT COST RELATIONSHIP: High

1. Project Benefit: High
    - Implementation would greatly reduce future expected losses. The flood hazard it mitigates has a medium to high probability of occurrence and the project significantly reduces the effects of frequent damaging events for a select population.
2. Cost Project: Low (doesn't include Public Works projects – See Action item 8
    - Project would have low cost to city in keeping residents informed. The cost would be significant to home owners if home elevation is need and higher costs to city if a berm is required

1. TARGET HIGHER RISK NEIGHBORHOODS FOR SPECIFIC RISK REDUCTION MEASURES - Ronald Bog																										
Scenario		Responsible Org. (Lead "L")												Status		Timing			Associated Hazards							
		Fire																								
Isolation	Temporary interruptions	Fire -- Operations	Fire -- Education	Public Works Director	Emergency Management Coordinator	Neighborhood Programs Coordinator	Police Chief	Pl. and Dev. Services Director	Communications Specialist	Parks and Rec. Dept.	Economic Dev. Manager	City Manager	New Item	Updated Item	Short term	Long term	Ongoing	Earthquakes	Hazardous Materials	Severe Weather	Landslides & Sinkholes	Flooding	Wildland Fire	Volcano	Tsunami/Seiche
	*			*	L	*		*		*	*	*		*		*						*			

F. LITTLES CREEK AREA

RISK: Community comprises a small cluster of homes built on alluvial deposits created by Thornton Creek. Homes are subject to intensified ground shaking during an earthquake.

ACTION ITEMS: Provide a discussion of opportunities in taking advantage of City Retrofitting Program Discussion could be within context of "Map Your Neighborhood Program" through Ridge Crest Neighborhood Association.

Ranking by Emergency Management Council (EMC) and Community Response Team (CERT): Both the EMC and CERT ranked this sub item 5.

MITIGATION PLAN GOALS MET BY ACTION ITEM:

- Protect health, welfare and public safety
- Minimize losses to properties

FUNDING: Shoreline Operating Budget

BENEFIT / COST RELATIONSHIP: Medium

1. Project Benefit: Medium
    - Neighborhood is small and isolated, and is subject to increased earthquake generated ground shaking and liquefaction.
2. Project Cost: Low

1. TARGET HIGHER RISK NEIGHBORHOODS FOR SPECIFIC RISK REDUCTION MEASURES - Little Creeks Area																										
Scenario		Responsible Org. (Lead "L")												Status		Timing			Associated Hazards							
		Fire																								
Isolation	Temporary interruptions	Fire -- Operations	Fire -- Education	Public Works Director	Emergency Management Coordinator	Neighborhood Programs Coordinator	Police Chief	Pl. and Dev. Services Director	Communications Specialist	Parks and Rec. Dept.	Economic Dev. Manager	City Manager	New Item	Updated Item	Short term	Long term	Ongoing	Earthquakes	Hazardous Materials	Severe Weather	Landslides & Sinkholes	Flooding	Wildland Fire	Volcano	Tsunami/Seiche
	*				L	*								*	*			*				*			

2. CONTINUE AND EXPAND THE DELIVERY OF RISK REDUCTION OUTREACH PROGRAMS BY CITY & FIRE STAFF, TO GENERAL POPULATIONS OF HOUSEHOLDS AND BUSINESSES.

RISK: Although there is an increased risk associated with specific land areas, all of Shoreline is vulnerable to risks including intense earthquake generated ground shaking. Shoreline staff does not have the resources to maximize risk reduction opportunities by itself. The City does possess in-house talent with the ability to develop the knowledge and skills associated with reducing risk. This capability could be developed and directed at training others to assume and share risks, and institute appropriate mitigation measures.

ACTION ITEMS:

1. Develop a cadre of trained staff to conduct ATC 20 and 21 surveys and be available to train citizen groups on risk reduction measures. The Applied Technology Council (ATC) has developed an approach where by individuals familiar with basic building construction practices, but not necessarily being engineers, can provide rapid visual screening of buildings for potential seismic hazards (ACT 21) and performs post earthquake safety evaluations of buildings (ATC 21).

    - City and Fire Department staff familiar with construction techniques will be trained in ATC 20 and 21.
    - Perform predisaster surveys (ATC 21 for higher occupancy and critical buildings and as time permits, upon request).
    - Information gathered during these surveys would build a database that would help drive preparedness / mitigation outreach efforts and be available for post disaster assessments. (ATC 20).

2. Task the ATC trained staff to support continued efforts to promote non-structural earthquake mitigation within City facilities. Many of the City functions will be relocated to a new and earthquake resilient structure.

    - The City Emergency Management Coordinator currently instructs employees and City volunteers on preparedness and non structural measures. These ATC trained staff would support continued instruction for all employees.

- If respective staffs do not prove adequate, the City could partner informally or formally with local engineering and architect forms. Formal relationships would be possible through Building Occupancy Resumption Program (BORP) type agreements.

3. Create an "All-hazards" resource pool to advise City/Fire staff and City residents on risk reduction measures associated with all hazards.

   - Identify staff resources knowledgeable in major risk categories.
   - Areas that fall into the high probability of soil erosion, liquefaction or soft soil shall be reviewed as a critical area with special concern due to extenuating circumstances with regards to vegetation removal, soils alteration and plantings.
   - All-hazards Pool, to include the ATC trained staff, will be available to Neighborhood Coordinator to provide resources to targeted high risk communities as well as the other neighborhoods. (See Action item 1)
   - ATC trained staff will support a comprehensive seismic risk reduction outreach effort through consultations, presentations and workshops administered the City's Building Official with support from the Emergency Management and Neighborhood Coordinators. These activities would take advantage of the knowledge and skills developed in conducting ATC 20 and 21 surveys.
     The Fire Educator and the Neighborhood and Emergency Management Coordinators should assure that mitigation information is readily available through flyers, websites and other resources. A sample of readily available sources include:
     - Fire (www.firewise.org ...)
     - Flooding (www.floods.org)
     - Landslides (http://www.ecy.wa.gov/programs/sea/landslides/)
     - Regional incident such as Winter Storms and Earthquake (http://www.shorelinewa.gov/index.aspx?page=457)
     - Earthquakes (www.crew.org and http://www.seattle.gov/emergency/programs/projectimpact/retrofit.htm
     - Stormwater (http://www.ecy.wa.gov/programs/wq/funding/lidprojects.html and http://www.ecy.wa.gov/programs/wq/Stormwater/
     - Specific populations (home, schools, business -- http://www.emd.wa.gov/preparedness/prep_index.shtml)Provide opportunities for staff trained in all-hazards mitigation and ATC to support a comprehensive risk reduction outreach efforts.

4. Refine existing outreach effort. Outreach program will take advantage of:

   - Trained ATC and All-hazards mitigation staff
   - "Map Your Neighborhood Program"

- Earthquake structural and nonstructural measures including the Shoreline "Home Retrofit Program"
- Stormwater risk reduction methods included within City adopted Department of Ecology Low Impact Development manual as retrofits (replacing hard surfaces with permeable ones, creating wet gardens.)
- Promoting Emergency Preparedness measures as illustrated on City website (http://www.shorelinewa.gov/index.aspx?page=457)

RANKING BY EMERGENCY MANAGEMENT COUNCIL (EMC) AND COMMUNITY RESPONSE TEAM (CERT): The EMC and CERT ranked this item 3 and 4 respectively.

MITIGATION PLAN GOALS MET BY ACTION ITEMS:

- Protect public health, welfare, and public safety
- Minimize losses to existing and future properties
- Encourage coordination and communication amongst public and private organizations
- Ensure continuity of critical facilities and corresponding operations of local government
- Protect and promote environmental quality

FUNDING: Shoreline Operating Budget

BENEFIT / COST RELATIONSHIP: High

1. Project Benefit: High
   - Implementation of this mitigation item is crucial to the long-term safety of all Shoreline stakeholders. It mitigates hazards with a high or medium probability of occurrence and has the potential to affect a great number of people.
2. Project Cost: Low

2. CONTINUE AND EXPAND THE DELIVERY OF RISK REDUCTION OUTREACH PROGRAMS BY CITY & FIRE STAFF, TO GENERAL POPULATIONS OF HOUSEHOLDS AND BUSINESSES.																											
Scenario		Responsible Org. (Lead "L")												Status		Timing			Associated Hazards								
		Fire																									
Isolation	Temporary interruptions	Fire -- Operations	Fire -- Education	Public Works Director	Emergency Management Coordinator	Neighborhood Programs Coordinator	Police Chief	Pl. and Dev. Services Director	Communications Specialist	Parks and Rec. Dept.	Economic Dev. Manager	City Manager	New Item	Updated Item	Short term	Long term	Ongoing	Earthquakes	Hazardous Materials	Severe Weather	Landslides & Sinkholes	Flooding	Wildland Fire	Volcano	Tsunami/Seiche
*	*		*	*	*	*		L						*			*	*	*	*	*	*	*	*	

3. INCREASE GIS CAPABILITY THROUGH PARTNERING WITH FIRE DEPARTMENT.

ACTION ITEM: The City of Shoreline and Shoreline Fire Department should partner to build, maintain and share data sets, and share staff resources to better exploit emerging information technologies.

RANKING BY EMERGENCY MANAGEMENT COUNCIL (EMC) AND COMMUNITY RESPONSE TEAM (CERT): The EMC and CERT ranked this item 8 and 6 respectively.

MITIGATION PLAN GOALS MET BY ACTION ITEMS:

- Protect public health, welfare, and public safety
- Minimize losses to existing and future properties
- Encourage coordination and communication amongst public and private organizations
- Ensure continuity of critical facilities and corresponding operations of local government
- Protect and promote environmental quality

FUNDING: Shoreline Operating Budget and Fire Department Operating Budget

BENEFIT / COST RELATIONSHIP: High

1. Project benefit: Medium – High
   - Benefits difficult to measure, but item would assure that all "where" questions can be more easily answered and has potential to save lives.
2. Project Cost: Low (may require providing for an additional FTE)

3. INCREASE GIS CAPABILITY THROUGH PARTNERING WITH FIRE DEPARTMENT.																										
Scenario		Responsible Org. (Lead "L")											Status		Timing			Associated Hazards								
		Fire																								
Isolation	Temporary interruptions	Fire -- Operations	Fire -- Education	Public Works Director	Emergency Management Coordinator	Neighborhood Programs Coordinator	Police Chief	PI. and Dev. Services Director	Communications Specialist	Parks and Rec. Dept.	Economic Dev. Manager	City Manager	New Item	Updated Item	Short term	Long term	Ongoing	Earthquakes	Hazardous Materials	Severe Weather	Landslides & Sinkholes	Flooding	Wildland Fire	Volcano	Tsunami/Seiche
*	*	L										L	*				*	*	*	*	*	*	*	*	*

4. THE CITY AND FIRE DEPARTMENT WILL PARTICIPATE IN THE PLANNING/ASSESSMENT ACTIVITIES OF UTILITY SERVICE PROVIDERS.

The utility service providers include:

1. Water--Shoreline Water District (east side of City) and Seattle Public Utilities (west side of city). SWD franchise agreement effective through 12/31/2011. SPU franchise agreement through 6/30/2009)
2. Wastewater – Ronald Wastewater and Seattle Public Utilities. RWW franchise agreement effective through 2017.
3. Electricity – Seattle City Light. SCL franchise agreement effective through 1/01/2014.
4. Natural Gas -- Puget Sound Energy. PSE franchise agreement effective through August 30, 2017.

RISKS: Shoreline does not own or directly operate or manage critical services. Franchise agreements between the City and the above providers allow for the planning, inspection, maintenance, repair and replacement of facilities they own, but are located within the City. With the exception of "Acts of Nature", liability lies with the provider. However, each of these agreements provides for planning coordination and each allows the City to "cooperate in planning and implementation of emergency operations, responses & procedures." Preparedness, mitigation and recovery procedures are not mentioned directly in any of the franchise agreements, but should be considered as being included as elements of response.

ACTION ITEMS:

- The Emergency Management Coordinator participates in planning activities with the objective of instituting resiliency and mitigation strategies within service provider plans.
- Add formal language to future franchise agreements such that reporting requirements for each provider would include a statement of how identified risks included within this Plan are being addressed. The franchise agreements for Puget Sound Energy will not expire until 2017 and 2011. However, Seattle Public Utilities and Ronald Wastewater may be renegotiated as early as June of 2009, and the Shoreline Water District agreement in 2011.
- Increase response capability to Tolt water supply line serving the west side of the city.

RANKING BY EMERGENCY MANAGEMENT COUNCIL (EMC) AND COMMUNITY RESPONSE TEAM (CERT): The EMC and CERT ranked this item 6 and 4 respectively.

MITIGATION PLAN GOALS MET BY ACTION ITEMS:

- Protect public health, welfare, and public safety
- Minimize losses to existing and future properties
- Encourage coordination and communication amongst public and private organizations
- Ensure continuity of critical facilities and corresponding operations of local government
- Protect and promote environmental quality

FUNDING: City of Shoreline and the Shoreline Fire Department Operating Budgets

BENEFIT / COST RELATIONSHIP: Medium

1. Project Benefit: Medium

   - Benefits difficult to measure, but item could protect property and possibly save lives.

2. Project Cost: Low

4. THE CITY AND FIRE DEPARTMENT WILL PARTICIPATE IN THE PLANNING/ASSESSMENT ACTIVITIES OF UTILITY SERVICE PROVIDERS																										
Scenario		Responsible Org. (Lead "L")												Status		Timing			Associated Hazards							
		Fire																								
Isolation	Temporary interruptions	Fire -- Operations	Fire -- Education	Public Works Director	Emergency Management Coordinator	Neighborhood Programs Coordinator	Police Chief	Pl. and Dev. Services Director	Communications Specialist	Parks and Rec. Dept.	Economic Dev. Manager	City Manager	New Item	Updated Item	Short term	Long term	Ongoing	Earthquakes	Hazardous Materials	Severe Weather	Landslides & Sinkholes	Flooding	Wildland Fire	Volcano	Tsunami/Seiche
*	*	L		L	*							*	*				*	*	*	*	*	*	*		*

5. ESTABLISH SAFE PLACES OF REFUGE WITHIN WALKING DISTANCE OF RESIDENTS

RISK: Severe winter storms and major earthquake can isolate many neighborhoods.

ACTION ITEMS:

- Identify possible places of refuge within walking distance of residences. Such facilities should have kitchens and, if possible, alternative power and could include churches, schools, and community centers
- Support the structural and nonstructural retrofitting of these centers.

RANKING BY EMERGENCY MANAGEMENT COUNCIL (EMC) AND COMMUNITY RESPONSE TEAM (CERT): The EMC and CERT ranked this item 4 and 2 respectively.

MITIGATION PLAN GOALS MET BY ACTION ITEMS:

- Protect public health, welfare, and public safety
- Encourage coordination and communication amongst public and private organizations

FUNDING: Possible HMGP/City/ Nonprofit Partnerships

BENEFIT / COST RELATIONSHIP: Medium

1. Project Benefit: Medium

   - Implementation would greatly reduce future expected losses. The hazard it mitigates has a medium probability of occurrence and has the potential of effecting a significant population. The action item

reduces the effects of frequent damaging events for select populations that could be isolated by a probable event.

2. Project Cost: Medium to Low. Costs could increase if identified place of refuge require retrofitting and the insulation of amenities such as kitchens.

5. ESTABLISH SAFE PLACES OF REFUGE WITHIN WALKING DISTANCE OF RESIDENTS																										
Scenario		Responsible Org. (Lead "L")												Status		Timing			Associated Hazards							
		Fire																								
Isolation	Temporary interruptions	Fire -- Operations	Fire -- Education	Public Works Director	Emergency Management Coordinator	Neighborhood Programs Coordinator	Police Chief	PI. and Dev. Services Director	Communications Specialist	Parks and Rec. Dept.	Economic Dev. Manager	City Manager	New Item	Updated Item	Short term	Long term	Ongoing	Earthquakes	Hazardous Materials	Severe Weather	Landslides & Sinkholes	Flooding	Wildland Fire	Volcano	Tsunami/Seiche
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6. DEVELOP AND DELIVER BUSINESS OUTREACH PROGRAM.

RISK: Shoreline businesses are uniquely vulnerable to being isolated from their markets and suppliers, and to the loss of power.

ACTION ITEMS:

- Develop a specific outreach program through the City Economic Development Manager promoting existing contingency planning tools available through the Washington EMD Business Portal (http://www.emd.wa.gov/preparedness/prep_business.shtml).
- Encourage businesses to partner thereby sharing resources and risks. (e.g. cold storage, alternative power)

RANKING BY EMERGENCY MANAGEMENT COUNCIL (EMC) AND COMMUNITY RESPONSE TEAM (CERT): Both the EMC and CERT ranked this item 5.

MITIGATION PLAN GOALS MET BY ACTION ITEMS:

- Protect public health, welfare, and public safety
- Minimize losses to existing and future properties
- Encourage coordination and communication amongst public and private organizations
- Ensure continuity of critical facilities and corresponding operations of local government

FUNDING: City Business Partnerships

BENEFIT / COST RELATIONSHIP: Medium

1. Project Benefit: Medium

   - There are numerous business centers scattered throughout Shoreline. Many are independent and interdependent services centers that if unavailable following an event would reduce community sustainability. This would increase dependency on government services for Shoreline residents at large and cause many businesses and business oriented neighborhoods to fail.

2. Project Cost: Low

6. DEVELOP AND DELIVER BUSINESS OUTREACH PROGRAM.																											
Scenario		Responsible Org. (Lead "L")												Status		Timing			Associated Hazards								
		Fire																									
Isolation	Temporary interruptions	Fire -- Operations	Fire -- Education	Public Works Director	Emergency Management Coordinator	Neighborhood Programs Coordinator	Police Chief	Pl. and Dev. Services Director	Communications Specialist	Parks and Rec. Dept.	Economic Dev. Manager	City Manager	New Item	Updated Item	Short term	Long term	Ongoing	Earthquakes	Hazardous Materials	Severe Weather	Landslides & Sinkholes	Flooding	Wildland Fire	Volcano	Tsunami/Seiche
*	*		*		*	*					L			*			*	*	*	*	*	*			

7. RETROFIT OR REPLACE VULNERABLE CITY OWNED FACILITIES AND INFRASTRUCTURE.

RISK: Most Shoreline owned facilities and City infrastructure have been structurally retrofitted to better accommodate earthquakes. Nonstructural measures have also been instituted and employees have been instructed on nonstructural earthquake reduction measures. The only exceptions are Police facilities and the 196th Street Bridge.

ACTION ITEMS:

- Police facilities: Shoreline Police operate from three facilities none of which have been seismically retrofitted. Main Shoreline Police Facility at 1206 N 185th St, Shoreline

    - Assess facilities to identify possibility of retrofitting facility(ies) such that adequate functionality would be available following a damaging earthquake.

    - Undertake detailed FEMA benefit cost analysis of retrofitting police facility(ies) to determine eligibility for FEMA funding. (Action item included in 2004 HM Plan)

    - Until functionality can be assured locate a facility that would provide an adequate post earthquake operation and command alternative.

- 196th Bridge: This bridge proves sole access to the Apple Tree Lane community. The bridge has been determined to be vulnerable from peak acceleration (%g) with a 10% probability of exceedance in 50 years. Apple Tree Lane is home to 30 or so families located along the western shore that could be easily isolated by winter storms, tsunamis or and earthquake.
    - Replace bridge with new bridge starting construction in 2010. A temporary bridge will be installed during construction of a new bridge.
    - Make plans/preparations to provide alternative emergency access opportunities over the rail tracks and on to Richmond Beach Drive until the new bridge is constructed.

RANKING BY EMERGENCY MANAGEMENT COUNCIL (EMC) AND COMMUNITY RESPONSE TEAM (CERT): Both the EMC and CERT ranked this item 1.

MITIGATION PLAN GOALS MET BY ACTION ITEMS:

- Protect public health, welfare, and public safety
- Minimize losses to existing and future properties
- Encourage coordination and communication amongst public and private organizations
- Ensure continuity of critical facilities and corresponding operations of local government

FUNDING:

- Shoreline Operating Budget
- Possible support through HMGP

BENEFIT / COST RELATIONSHIPS: Medium – High (Depending on implementation costs)

1. Project Benefit: High
    - Implementation of this mitigation item is crucial to the long-term safety of all Shoreline stakeholders. It mitigates earthquake and winter storm hazards with a high or medium probability of occurrence and has the potential to affect a great number of people.
2. Project Cost: Medium to High
    - Non structural retrofits can be very inexpensive, however structurally retrofitting major facilities such as the police station or 196 Street Bridge can be very expensive and retrofitting may not be cost effective and new facilities will need to be built.

7. RETROFIT OR REPLACE VULNERABLE CITY OWNED FACILITIES AND INFRASTRUCTURE.																										
Scenario		Responsible Org. (Lead "L")												Status		Timing			Associated Hazards							
		Fire																								
Isolation	Temporary interruptions	Fire -- Operations	Fire -- Education	Public Works Director	Emergency Management Coordinator	Neighborhood Programs Coordinator	Police Chief	Pl. and Dev. Services Director	Communications Specialist	Parks and Rec. Dept.	Economic Dev. Manager	City Manager	New Item	Updated Item	Short term	Long term	Ongoing	Earthquakes	Hazardous Materials	Severe Weather	Landslides & Sinkholes	Flooding	Wildland Fire	Volcano	Tsunami/Seiche
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8. REDUCE FLOOD DAMAGE WITHIN RONALD BOG COMMUNITY.

RISK: The residents of the Ronald Bog area of the Meridian Park Neighborhood have experienced property damage during very large rain events. In particular, this area has flooded four times in the recent past: January 18, 1968, January 1, 1997, October 20, 2003, and December 3, 2007. The City is committed to working with these residents to mitigate the damages they suffer and has hosted meetings with the residents and FEMA to inform the residents of FEMA insurance requirements. The City has completed installation of an early warning system that shows the current bog level. This information can be accessed on the City website by the public and staff, and can also be monitored by staff via an automated message system. When the water elevation in bog reaches a certain elevation, City Staff are notified and can initiate a Reverse 911 through the Shoreline Fire Department to the residents of the neighborhood.

ACTION ITEMS:

- Delineation of a 100-yr FEMA floodplain
- Completion of the Interim Flood Management Plan
- Meeting with residents in Fall 2009 to discuss Interim Flood Management Plan.
- Further development and evaluation of capital improvements that meet FEMA standards including a berm along the south edge of the bog and/or floodproofing of homes.

RANKING BY EMERGENCY MANAGEMENT COUNCIL (EMC) AND COMMUNITY RESPONSE TEAM (CERT): Both the EMC and CERT ranked this item 7.

MITIGATION PLAN GOALS MET BY ACTION ITEM:

- Protect public health, welfare, and public safety
- Minimize losses to existing and future properties

FUNDING: Shoreline Operating Budget

BENEFIT / COST RELATIONSHIP: Medium

1. Project Benefit: Medium

   - Implementation would greatly reduce future expected losses. The flood hazard it mitigates has a medium to high probability of occurrence and the project significantly reduces the effects of frequent damaging events for a select population.

2. Cost Project: Medium

   - Project would have low cost to city in keeping residents informed. The cost would be significant to home owners if home elevation is needed and higher costs to the city if a berm is required.

8. REDUCE FLOOD DAMAGE WITHIN RONALD BOG COMMUNITY.																										
Scenario		**Responsible Org. (Lead "L")**												**Status**		**Timing**			**Associated Hazards**							
		Fire																								
Isolation	Temporary interruptions	Fire -- Operations	Fire -- Education	Public Works Director	Emergency Management Coordinator	Neighborhood Programs Coordinator	Police Chief	Pl. and Dev. Services Director	Communications Specialist	Parks and Rec. Dept.	Economic Dev. Manager	City Manager	New Item	Updated Item	Short term	Long term	Ongoing	Earthquakes	Hazardous Materials	Severe Weather	Landslides & Sinkholes	Flooding	Wildland Fire	Volcano	Tsunami/Seiche
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CHAPTER 8 PLAN MAINTENANCE

According to Title 44 of the Code of Federal Regulations (CFR) Section 201.6(c)(4)(i), a Hazards Mitigation Plan (HMP) must include a plan maintenance process that includes the following:[36]

- Requirement §201.6(c)(4)(i): A section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.
- Requirement §201.6(c)(4)(ii): A process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.
- Requirement §201.6(c)(4)(iii): Discussion on how the community will continue public participation in the plan maintenance process.

Plan Maintenance Requirements

Requirement §201.6(b)(4) A plan maintenance process that includes:

(i) A section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.
(ii) A process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when

In accordance with 2004 HMP maintenance plan, the Emergency Management Coordinator reported to the City of Shoreline Emergency Management Council the status of the 28 mitigation strategies that the City of Shoreline staff and community partners were working towards.

The reporting on the Plan occurred on a quarterly basis each year. In 2005 reports were given orally to the council by staff members of the various departments. Beginning in 2006 the EMC began documenting progress in a work plan so that each Department would update their progress and the work plan could be emailed to the council in advance of the meeting. If there had been no change since the last update the Emergency Management Coordinator would accordingly verbally advise the Council. Also, after any significant event the event was reviewed with the EMC and Action Plans were written, detailing lessons learned and steps to mitigate the hazards in the future.

The 2004 HMP was reviewed by the EMC annually, and no changes were deemed significant enough to ask for a change in the Plan. The Plan has been posted on the City's web site and comment from the public has been sought. No one has yet sent a comment. Copies of Emergency Management Council Agendas and reports on the strategies can be found in the appendices.

This 2009 plan update maintenance section details the process that will continue the 2004 maintenance plan and will ensure that the City of Shoreline HMP remains a comprehensive and useful document throughout the five-year update cycle. The following plan maintenance process section outlines the procedure for monitoring and evaluating the plan and for producing an updated plan every five years. This section also explains how the City intends to incorporate the mitigation strategies outlined in the HMP

[36] ELECTRONIC CODE OF FEDERAL REGULATIONS. http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&rgn=div5&view=text&node=44:1.0.1.4.53&idno=44.

into existing plans and programs. Finally, this chapter describes how the City will integrate public participation throughout the plan implementation process.

MONITORING, EVALUATING, AND UPDATING THE HMP WITHIN A FIVE-YEAR CYCLE

The Shoreline Emergency Management Coordinator will continue to monitor the implementation of mitigation actions identified in the Plan. The Emergency Management Coordinator will also maintain adequate mitigation planning staff to monitor and evaluate the Plan. As part of the monitoring and evaluation processes, the Emergency Management Coordinator will work to:

- Provide a summary of any hazard events that occurred during the prior year and their impact on the EMC.
- Review successful mitigation strategies identified in the HMP.
- Provide a brief discussion about why certain strategies have not been implemented.
- Review the action items to determine if the timeline for identified projects needs to be amended or if there are changes in funding options or grant opportunities affecting these items.
- Create recommendations for new mitigation projects.
- Provide the EMC a report on impacts of any other planning programs or initiatives within the City that involve hazard mitigation.
- Assess the current version of the Plan and determine the improvements necessary for the five-year HMP update.
- Conduct site visits to obtain reports of completed or initiated mitigation strategies to incorporate in the plan update as needed.
- Research and document new natural disaster information pertaining to Shoreline during the five-year HMP update cycle.
- Organize annual meetings with the Emergency Management Council to discuss relevant hazard mitigation issues, provide status updates, and discuss available grant opportunities.
- Convene a meeting of the Emergency Management Council following a natural disaster or when funding is announced to prioritize and submit potential mitigation actions for funding.

Section 201.6.(d)(3) of Title 44 of the CFR requires that the HMP be reviewed, revised if appropriate, and resubmitted to FEMA for approval in order to remain eligible for funding given out by FEMA under the Disaster Mitigation Act (DMA).[37]

The HMP will be updated every five years to reflect the results of the annual reports and on-going plan monitoring and evaluation by the Emergency Management Coordinator and the Emergency Management

[37] ELECTRONIC CODE OF FEDERAL REGULATIONS. http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&rgn=div5&view=text&node=44:1.0.1.4.53&idno=44.

Council. Both will also assess and incorporate recommended comments expressed by FEMA in the initial review into the plan revision.

At the end of the planning cycle, the Emergency Management Coordinator will submit the updated Plan to the Emergency Management Division of the State of Washington for review and preliminary approval. The State will then submit the Plan to FEMA for a final review. After the State and FEMA have approved Shoreline's HMP, the City will formally adopt the Plan by a formal vote of City Council.

As part of this process, there will be minimum requirements that need to be met, including:

- The hazard risk assessment will be reviewed and updated using best available information and technologies on an annual basis.
- The evaluation of critical structures and mapping will be updated
- The action items will be reviewed and revised to account for any actions completed, dropped, or changed and to account for changes in the risk assessment or new City policies identified under other planning mechanisms, as appropriate (such as the Comprehensive Plan).
- The draft HMP update will be sent to appropriate agencies for comment.
- The public will be given an opportunity to comment prior to adoption.
- The Shoreline City Council will adopt the updated plan, as approved by FEMA.
- Incorporation into existing plan mechanisms

The HMP is based on information available at the time that the plan and its updates are written. In addition to the HMP, the City of Shoreline has a series of master plans, ordinances, and guidelines by which the City abides when considering planning and development.

Per Washington State's Growth Management Act (1990), Shoreline created and adopted a Comprehensive Plan in 1995 which is the primary guideline for the City's planning and development goals. Through adoption of this HMP, the City's Departments and City Council will coordinate the HMP recommendations with the recommendations of these additional documents, particularly as they pertain to achieving Comprehensive Plan goals and objectives. Although the City's Comprehensive Plan does not explicitly mention coordination with the HMP, many of the HMP strategies enhance the goals of the Comprehensive Plan.

The City of Shoreline currently utilizes several mechanisms to guide development, including the following:

- Comprehensive land use planning as required by the Washington State Growth Management Act
- Capital improvement planning
- Building codes

Each of these mechanisms can also be utilized to meet the goals of the Hazard Mitigation Plan. After the city officially adopts the Hazard Mitigation Plan, mitigation strategies will be implemented into these existing processes, plans and codes. After adoption of the Hazard Mitigation Plan, the city will assure that

they address hazard risk in their comprehensive plans and land use regulations. The city planning department will conduct periodic reviews of the city comprehensive plan, land use policies and analyze any plan amendments.

The city building department is responsible for administering the building codes in Shoreline. After the adoption of the Hazard Mitigation Plan, they will work with the state building code office to make sure that Shoreline adopts and enforces the minimum standards established in the new state building code. This is intended to assure that life/safety criteria are met for new construction.

Various city departments develop capital improvement programs and review them regularly. The capital improvement program is another avenue that can help fulfill the goals in Shoreline's Hazard Mitigation Plan. The Emergency Management Council will work with city departments to identify capital improvement projects that are consistent with the Hazard Mitigation Plan goals and integrate them as appropriate.

Within six months of the formal adoption of the Hazard Mitigation Plan, the policies listed above will be incorporated into the process of existing program and planning mechanisms.

Action items include:

1. Target higher risk neighborhoods for specific risk reduction measures.
2. Continue and expand the delivery of risk reduction outreach programs by City & Fire staff, to general populations of households and businesses.
3. Increase GIS capability through partnering with Fire Department.
4. City will participate in the planning/assessment activities of utility service providers.
5. Establish safe places of refuge within walking distance of residents.
6. Develop and deliver business outreach program.
7. Retrofit or replace vulnerable City owned facilities and infrastructure.

CONTINUED PUBLIC INVOLVEMENT

Shoreline is committed to continued public involvement in the hazards mitigation planning and review process. During all phases of plan maintenance, the public will have the opportunity to provide feedback. The 2009 Plan update will be maintained and available for review on the Shoreline website. Individuals will have an opportunity to submit comments for the Plan update at any time by e-mail.

Upon initiation of the next HMP update process, a new public involvement strategy will be created. This strategy will be based on the needs and capabilities of the City at the time of the update. At a minimum, this strategy will include the use of local media outlets within the planning area and the City's website prior to the submission of the next Plan update. Shoreline will post a notice on its website requesting feedback on an updated draft HMP.