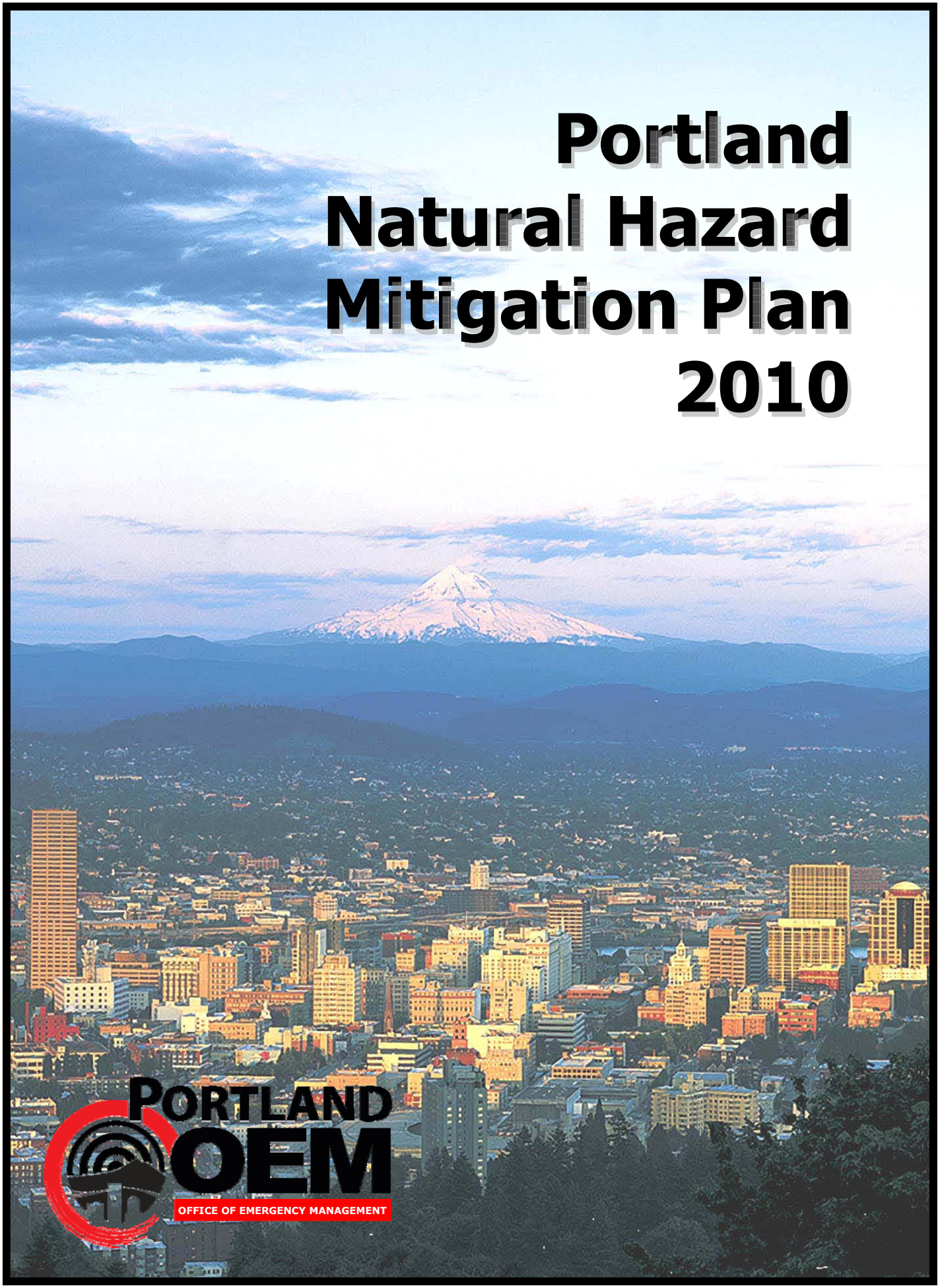
Portland Natural Hazard Mitigation Plan 2010



THANK YOU

City of Portland Natural Hazard Mitigation Plan Team & Reviewers
Carmen Merlo – Director, Portland Office of Emergency Management
Patty Rueter – Planning Manager, Portland Office of Emergency Management
Laureen Paulsen – Program Specialist, Portland Office of Emergency Management

Adrienne Edwards – Bureau of Development Services
Jed Sampson – Bureau of Development Services
Hank McDonald – Bureau of Development Services, Emergency Management Steering Committee

Maggie Skenderian – Bureau of Environmental Services
Colleen Mitchell – Bureau of Environmental Services
Ali Young – Bureau of Environmental Services
Brandon Davis – Bureau of Environmental Services, Wastewater
Paul Suto – Bureau of Environmental Services, Wastewater
John McGregor – Bureau of Environmental Services, Emergency Management Steering Committee

Matthew Silva – Portland Fire & Rescue, Emergency Management Steering Committee
Kelli McIntire – Portland Fire & Rescue

Mark Wilson – Portland Parks & Recreation
Dan Moeller – Portland Parks & Recreation
Barbara Aguon – Portland Parks & Recreation, Emergency Management Steering Committee

Steve Dotterrer – Bureau of Planning & Sustainability
Steven Koontz – Bureau of Planning & Sustainability
Roberta Jortner – Bureau of Planning & Sustainability
Tricia Sears – Bureau of Planning & Sustainability
Kevin Veaudry Casaus – Bureau of Planning & Sustainability

Larry Stevens – Portland Bureau of Transportation
David Harrington – Portland Bureau of Transportation, Emergency Management Steering Committee
Tom Caufield – Portland Bureau of Transportation
David O'Longaigh – Portland Bureau of Transportation

Jamaal Folsom – Portland Water Bureau
Perry W. Hopkins – Portland Water Bureau, Emergency Management Steering Committee

Subject Matter Experts
Bill Burns – Engineering Geologist, Department of Geology and Mineral Industries
Dr. Scott Burns – Chair, Portland State University Geology Department
Dr. Philip Mote – Director, Oregon Climate Change Research Institute
James Roddey – Earth Sciences Information Officer, Department of Geology and Mineral Industries
Tyree Wilde – Warning Coordination Meteorologist, National Weather Service

Portland State Interns
Chris Benn – Masters Candidate, Geology
Karline Klamp – Masters Candidate, Human Geography
Kathleen O'Brien – Masters Candidate, Geology
Lisa Peffer – Masters Candidate, Urban Planning

URS Corporation – Contractor

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EXECUTIVE SUMMARY

Hazard mitigation planning is a process in which hazards are identified and profiled, people and facilities at risk are assessed for threat and vulnerability then mitigation actions are developed. The result of the process is an integrated and coordinated effort to mitigate hazards. The expected outcome of all actions of the City of Portland 2010 Natural Hazard Mitigation Plan (NHMP) is to lessen the impact of damage caused by natural hazards to life, the economy, infrastructure or our ability to continue to operate as a community and city. The purpose of the 2010 NHMP is to document these actions and determine priorities and implementation efforts.

In response to Federal Emergency Management Agency (FEMA) Disaster Mitigation Act of 2000 (DMA2000) requirements, Portland submitted their first Natural Hazard Mitigation Plan in 2005. The DMA2000 required every state, county and city receiving federal mitigation funds to have a NHMP. FEMA guidelines for developing plans were established in September of 2002 and Portland's process began in early 2004.

The 2010 update to the 2005 NHMP, identifies eight natural hazards and 102 action items. The hazard analysis used in the 2005 plan was last updated in 2006 and will be updated again in 2011 by Portland Office of Emergency Management. The natural hazards that this plan will address over the next five years are (listed in order of impact and then frequency of occurrence):

- Earthquake
- Severe weather
- Flood
- Landslide
- Erosion
- Wildland urban interface fire
- Invasive plant species
- Volcanic activity

Public Involvement and Inter-Bureau Coordination

The highest priority of the 2010 NHMP list of actions is to "Continue to involve the public in updating the Natural Hazard Mitigation Plan". City mitigation projects implemented during the past five years engaged public involvement as a part of their work plans. The Johnson Creek East Lents Floodplain Restoration Project, the Portland Wildfire Fuel Reduction Project Wildfire Readiness Assessment and Gap Analysis and the Water Bureau's Conduit Trestle project all had significant public involvement in the implementation of their projects. Each public involvement process identified how actions will mitigate the impact of the hazard.

The 2010 NHMP public involvement process began by involving subject matter experts from Department of Geology and Mineral Industries (DOGAMI), National Weather Service (NWS), Portland State University (PSU) Geology Department, interns from the PSU Masters Program, and the Oregon Climate Change Institute.

A benefit of the 2010 NHMP is the identification of bureau projects and plans that already address mitigation as a part of their efforts. Plans that intersect the 2010 NHMP and through their existence strengthen the effort of lowering risk due to hazards include:

- Portland Plan
- 2009 Climate Action Plan
- Park Natural Vegetation Surveys (2004 – 2006)

- Wildfire Risk Assessment and Gap Analysis Plan (2009)
- Portland Asset Status and Conditions Report (2007 and 2008)
- Portland Urban Forestry Management Plan (2004)
- Portland Invasive Plants Strategy Report (2008)
- City of Portland Erosion and Sediment Control Manual (2008)

Identifying action items within these plans that are also mitigation strategies aligns funding opportunities and introduces new disciplines to emergency management preparedness and hazard mitigation.

Hazard Profiles

Creating a Community Mitigation Action Plan is just one of the multi-hazard action items identified in the 2010 NHMP. Other items are to identify critical transportation infrastructure and create a risk assessment tool that uses the scientific mapping of Light Detection and Ranging (LiDAR) to further verify the natural hazard areas of Portland. Partnering with utilities, the development of education materials and revising the Comprehensive Plan to implement citywide hazard mitigation policies are additional actions that, when implemented, would address many of the eight natural hazards and lessen the hazard impact on our assets.

Listed in order of impact and then frequency of occurrence, the 2010 NHMP committee determined that the number one threat to the Portland area was earthquake.

Earthquake

Key strategies focused on critical infrastructure strengthening of water, sewer and energy facilities:

- Update vulnerability analysis of Columbia Boulevard Wastewater Treatment Plant.
- Prioritize the return of power to treatment plants.
- Assess the vulnerability of the water distribution system to seismic events.

Recent research shows the Cascadia Subduction Zone is capable of producing a Magnitude (M) 9.0 earthquake. The risk of damage to structures and human life is greater today because of the increase and concentration of the population. Portland's proximity to the Pacific Coast (within 70-90 miles) makes a Cascadia generated Subduction Zone earthquake a great concern to geologists. DOGAMI experts have stated that the probability of a subduction zone earthquake occurring is greater than those potentially generated by more localized faults. There are three localized faults in the Portland area which have the potential of generating a M 6.5 earthquake.

The largest recorded earthquake epicenter within 100 miles of Portland occurred in Scotts Mills on March 25, 1993, which measured M 5.6 and caused sporadic minor damage to buildings. The ground shaking was intense enough to require the deployment of damage assessment teams to perform bridge and key infrastructure inspections.

During strong ground shaking events, unreinforced masonry (URM) facade construction (found throughout the city) poses extreme hazards, debris management issues and reconstruction concerns. The seismic stability of Portland's buildings will be an important part of the hazard analysis as 60% of Portland buildings were constructed before earthquake retrofit building codes were instituted in 1978. Not all facilities will be impacted the same. The City of Portland

has been seismically strengthening fire stations and police precincts, City Hall, the 1900 Building and utility facilities.

Recent regional transportation system analysis outlined which roadways will be cleared first to allow for emergency vehicle response. City owned overpass and bridge ramps have been assessed and prioritized for retrofit projects. Additional studies will be conducted to identify vulnerable infrastructure and potential resources to improve their resiliency.

Severe Weather

Key strategies to protect the population during severe weather:

- Acquire additional storage for anti-icing materials.
- Insulate residential buildings that house at risk populations.

Climate change influences create increased weather volatility such as hotter summers (drought), colder winters, intense thunderstorms, lightning, hail, snow storms, freezing rain/ice storms, high winds and tornadoes within and around the city. Climate change will impact more than just the weather and is referenced many times in the mitigation plan. The actions that reduce the effects of climate change are also lowering the impact of flooding, landslide and wildfire; such as promoting the increase and protection of the tree canopy and planting indigenous plants with deep root systems.

The city is subject to severe weather pattern shifts. Several historic events have affected the city, such as severe thunderstorms and periods of below freezing temperatures. In the last week of July 2009, a heat wave occurred in Portland and broke several heat records for the area. Just seven months earlier, in December of 2008, the City experienced three major snowstorms that produced historically significant snowfall amounts. This series of winter storms is described as one of the worst and most severe in the last 60 years and resulted in 18.9 inches of snow by the end of December 2008.

Climate change experts project that temperatures will increase 6 degrees by 2080. Precipitation is also projected to increase, though less substantially than temperature, at an average rate of 3.8 percent by 2080. The actual magnitude of these increases is dependent on future greenhouse gas emissions. More frequent periods of drought due to climate change are of particular concern for the Pacific Northwest. This region relies on a robust winter snowpack for water storage during the summer months. Projected changes in temperature will likely reduce the winter snowpack and cause more snow to fall as rain, subsequently affecting April to September stream flow. Flood risk is greatest in systems where more wintertime precipitation falls as rain rather than snow. Precipitation is predicted to increase in winter and decrease in summer. For the Portland area our once year round moderate climate will become more severe in its changes from season to season.

The most vulnerable citizens of Portland are those that have limitations in their accessibility to services or those dependent on others to provide for them. This could include the elderly, young, poor, homeless and those with physical limitations. Severe weather has the greatest impact on the most vulnerable citizens so mitigation actions address their needs first. Such strategies are to insulate the residential buildings that house at-risk populations and prioritize existing building stock for review against the dangerous building code (Title 29). Through

improving the programs and services for the most vulnerable so they can sustain through severe weather, less costs will be incurred in sheltering, health care and emergency response.

Flood

Key strategies to mitigate flooding:

- Ensure space below the base flood elevation is not converted to habitable space.
- Apply for Community Rating System Class 5 recertification.

The City is an active National Flood Insurance Program (NFIP) participant and has pursued the Community Rating System (CRS) classification since 2001. The city's current rating of 5 allows subscribers of flood insurance policies to receive a 25% reduction to their insurance premiums. A rating of 5 is one of the highest in the nation and validates Portland's flood management program as going beyond the minimum requirements for flood insurance standards.

Significant historic flooding has been recorded for both the Willamette and Columbia River basins in 1861, 1880, 1881, 1909, 1913, 1927, 1928, 1942, 1946, 1948, 1961, 1964/65, 1996 and 2007. On Memorial Day of 1948, the dike system along the Columbia River was breeched resulting in a catastrophic flood covering the city of Vanport with 10 to 20 feet of water and displacing 18,500 residents. In 1996, Portland received 24 hours of rainfall resulting in 3.04 inches of rain melting accumulated snow and causing all creeks to surpass flood stage. This flood was ranked the third largest flood on Johnson Creek in terms of stream flow.

The city typically experiences flooding after more than three days of heavy rainfall or when saturated conditions combine with significant rainfall or storms over short periods of time. These conditions continually place the city's floodplain developments at risk. The city has experienced more than $200 million in flood damage to both private and public property in the past three decades.

Areas vulnerable to flood in Portland are at low elevation along streams and rivers. The Columbia River and Lower Columbia Slough also pose a potential threat to the floodplain. Properties protected by the Multnomah County Drainage Districts system of dikes are valued at $20 billion and include the Portland Expo Center, Portland International Airport, Portland International Raceway and 8,000 to 10,000 jobs in transportation and warehousing. Any new development along a rivers edge needs to be assessed against the risk of flood.

Landslide

Key strategies to mitigate landslides:

- Continue to maintain and improve City communications to facilitate coordination of mitigation activities.
- Mitigate Portland's water supply infrastructure from landslide hazards.
- Develop a comprehensive landslide map for the City.

Landslides have created a number of problems in and around Portland's hills. Landslides result in private property damage, many impact transportation corridors, fuel and energy conduits and communication facilities. The impact of landslides on property and life safety will only increase as population increases and development advances into more landslide-prone urban areas.

Landslides can be triggered by earthquakes, prolonged or intense precipitation, as a result of vegetation removal, construction projects or volcanic eruptions.

Steep slopes, abundant precipitation and in some areas weak soils make Portland susceptible to landslides. Landslides occur primarily in four areas. More than half of the 700 slides that occurred during 1996 were in the Portland West Hills where weak, silt-rich soils become easily saturated and fail. A second area of concern includes the steep slopes along the Willamette River such as Oaks Bottom and Swan Island. In SE Portland, reactivation of ancient landslides is a large problem on deposits of fine-grained Troutdale Formation sediments. The fourth landslide prone area includes the steep creeks along the Columbia and Willamette Rivers where debris flows occur.

Erosion

Key strategies to mitigate erosion:

- Develop recommendations for streamside plants that provide erosion control.
- Implement projects that retain native vegetation and increase vegetation diversity.

During severe storm events riverine erosion is magnified due to increased volume and velocity of water flow. All rivers and creeks are subject to erosion. The city has two rivers and multiple streams and creeks that are potentially threatened. Erosion occurrences are typically secondary events that are directly linked to other hazard events such as flood, severe weather, landslide and wildland urban interface fires.

The 2008 Erosion and Sediment Control Manual is a key reference for actions to be taken to mitigate erosion in development and maintenance situations. This plan extends the vulnerability to not only riverine areas, but any location where land is being moved and impacting natural areas.

Erosion is a newly listed hazard in the 2010 NHMP. New data and mitigation strategies will be a part of the multi-bureau coordinated effort over the next five years. Most items in the current 2010 NHMP strategy relate to river and stream bank vegetation and careful management of steep sloped areas.

Wildland Urban Interface Fire

Key strategies to mitigate wildland urban interface fire:

- Review feasibility of adopting nationally recognized codes to strengthen building standards in wildfire risk areas.
- Complete an assessment to characterize high priority wildfire risk areas.

Portland covers 87,040 acres. Of these, 14,500 acres are categorized as natural areas and stream corridors. The city's natural areas designated as wildfire hazard areas include Powell Butte, the Willamette Bluffs, Marquam Nature Park, Terwilliger Wildlands, Kelly Butte, Rocky Butte and Mt. Tabor. The two largest areas are Forest Park and Powell Butte. These natural areas have been identified as high risk by the Oregon Department of Forestry and Portland Fire and Rescue because high-density commercial and residential development immediately surround the natural area parks and open spaces.

Forest Park had major fires in 1889, 1940 and 1951. In August of 2000 the Willamette Bluffs fire started when a two-mile section of grass and brush ignited along the railroad tracks at the base of a bluff. The fire grew quickly in the grasses and invasive Himalayan blackberry, threatening homes at the top of the bluff and engaging a five-alarm response from Portland Fire and Rescue.

Since 2006, Portland Parks and Recreation, Bureau of Environmental Services and Portland Fire and Rescue have begun work to reduce hazardous wildfire fuels by removing non-native and invasive vegetation in the most highly threatened natural areas and adjacent open space areas. In the fall of 2009 the Portland City Council approved the formation of a City/County Wildfire Technical Committee and subsequently began the development of a Community Wildfire Protection Plan which focuses on community involvement for wildfire protection.

Invasive Plant Species

Key strategies to mitigate the impact of invasive plants:

- Clarify zoning regulations to require removal of plants on the Nuisance Plan List.
- Initiate a process to ensure the Erosion Control Manual is consistent with City goals to control and eradicate invasive plants.

Invasive plants, though not a hazard event, are a current environmental condition that imposes greater vulnerability and greater loss on the natural environment because of their presence. Removing invasive plants strengthens the environment and mitigates the impact of landslide, erosion, wildland urban interface fire and flood.

Invasive plants are plants introduced into an environment in which they did not originate. They lack natural enemies, grow and reproduce quickly and are able to thrive in a wide variety of conditions. These characteristics allow plants to invade new habitats and out-compete native plants resulting in dense thickets of a single plant species. Dense thickets of invasive plants limit native plant diversity which in turn reduces food and shelter for wildlife. Invasive plants are the second leading cause of species extinction. Many invasive plants have shallow root systems that provide limited erosion control. Invasive plants also shade out native seedlings resulting in fewer trees. Less shade creates higher water temperatures, reducing oxygen for fish and other aquatic animals. Reduced tree cover decreases storm water interception and absorption of carbon dioxide (CO^2) which interferes with the stabilization of the earth's temperature.

Invasive plants cover 13 to 40% of the 7,800 acres surveyed by Portland Parks and Recreation which extrapolates out to 4,181 to 12,864 acres of invasive plants within the city limits. In a national study of 12 different invasive plant species, the median cost of early detection, control and eradication was $1 for every $17 of future potential damage caused by the species. Mitigation actions identify the connection between invasive plant management and the impacts on climate change which is a major cause of severe weather.

Volcanic Activity

The four closest volcanoes to the city are Mt. Adams, Mt. Hood, Mt. St. Helens and Mt. Jefferson. Each of these mountains is part of an extensive chain of volcanoes formed by earthquakes from the Cascadia Subduction Zone. Mt. St. Helens is believed to be the volcano with the greatest potential to have a near-term impact on the region because of its ongoing activity since the cataclysmic event in May 1980. A large eruption of Mt. St. Helens can eject ash over an area of 40,000 square miles or more. Wind direction and velocity, along with the vigor and direction of the eruption will control the location, size and shape of the area affected by ash fall.

The most predominate threat to the city is volcanic ash fall. Events can vary from minor to heavy with minor events reducing visibility and increasing respiratory and breathing difficulty. Driving can become potentially treacherous from reduced visibility and particulate ingested engine damage.

Summary

Actions of the 2010 NHMP identify the work that needs to involve community and multiple bureaus to reduce the City's vulnerability and risk to natural hazards. The city cannot eliminate the hazards but it can work to educate and elevate awareness of what individuals, business and organizations can do to protect their lives and livelihood through proactive planning. City policies for development and asset management, including risk of natural hazards, assure the time and energy investments build a resilient city.

Section 1 Introduction

1.1 INTRODUCTION

The City of Portland NHMP provides a multi-bureau, multi-hazard, Council approved set of actions that could improve the City's disaster resilience. The City depends on business and property taxes, licenses and fees to operate public safety, infrastructure and essential services. Through the identification of mitigation action items, risk to the continued operations of City services and the impact of the hazards to business and property could be minimized by incorporating hazard reduction measures in planning maintenance, improvement and development investment projects. This plan outlines City mitigation actions that are protecting the public's investment. Important issues are:

- Portland is subject to substantial natural hazard risks. Of the 1,037 "major disaster declarations" in the US between 1972 and 2000, the state of Oregon has claimed 19, ranking it 33rd in the number of disaster declarations for any state or territory. Total aggregated losses from natural disasters in Oregon have reached into the hundreds of millions of dollars during the past decade.
- Seismic activity, heavy precipitation, weather extremes and geographic influences will continue to result in earthquakes, floods and landslides. In addition, periods of long dry summers and fuel accumulation (tree, grass and understory growth) contribute to the potential for wildfires.
- During the winters of 1996 and 1997, the Portland area experienced floods, landslides and ice storms. Over $220 million was provided to Oregon under several federal relief programs for three flood and landslide disasters that occurred in 1996 and 1997.
- Portland assets equal over $59 billion, including residential and commercial structures and building contents, critical facilities and infrastructure (utilities and transportation lifelines).
- The banks of the Willamette River are at risk of flood, landslide, liquefaction and erosion. They are also areas of significant development for industry, housing and leisure activities. The combination of population use of the riverfront areas and the hazards that could impact them creates a greater potential risk of loss.

Hazard mitigation, as defined in Title 44 of the Code of Federal Regulations (CFR), Part 201, §201.2, is "any sustained action taken to reduce or eliminate the long-term risk to human life and property from natural hazards." Hazard mitigation is any work done to minimize the impacts of any type of hazard event before it occurs. It aims to reduce losses from future disasters. Hazard mitigation planning is a process in which hazards are identified and profiled, people and facilities at risk are analyzed and mitigation actions are developed. The result of this process is an integrated and coordinated effort to mitigate hazards.

1.2 NHMP COMPLIANCE DOCUMENTATION DESCRIPTION

Appendices at the end of this document provide documentation verifying compliance. Throughout this document the FEMA crosswalk criteria is highlighted in red at the beginning of the section that contains the supporting documentation.

Appendix A FEMA Crosswalk Documenting Compliance with FEMA Criteria

Appendix B Adoption Resolution for the City

Appendix C Planning Process and Requirements

Appendix D Public Involvement

Appendix E Benefit-Cost Analysis Fact Sheet

Appendix F Plan Maintenance Documents

Appendix G Acronyms and Abbreviations

Appendix H References

Appendix I National Flood Insurance Program Compliance Information

Appendix J Maps

1.3 PORTLAND HAZARDS AND SUCCESSES

(Organized by severity and frequency - earthquake being the most severe, weather being the most frequent and expansive)

Earthquake

- Three crustal faults are predicted to have the potential of a 6.8 magnitude.
- Portland is within the Cascadia Subduction Zone impact area capable of producing a 9.0 magnitude quake.

Severe Weather*

- Including snow and ice storms, wind, drought and extreme temperature.
- Projected changes in temperature over the next 100 years will likely reduce the winter snowpack and cause more snow to fall as rain; more frequent periods of drought, dryer summers, increased fire danger and higher levels of pollution in the Portland area.

Flood

- Flooding most often occurs from October through April.
- 31 miles of levees protect the Portland International Airport and over $3 billion of commerce along the Columbia River.
- Johnson Creek floods annually displacing residents and business owners.

Landslide

- Portland has slopes of 20% grade in the west hills, above Swan Island north of University of Portland, along the ridges of Mt. Tabor, Mt. Scott, Powell Butte and Rocky Butte.
- Ninety landslides were recorded from 2005-2009 in the Portland area.

Wildland Urban Interface Fire

- Portland's largest natural area - the 5,500 acre Forest Park - is surrounded on three sides by industrial and residential development.
- The risk of loss to homes and businesses built at the wildland urban interface is significant and growing due to the buildup of hazardous wildfire fuels (including invasive species), longer dry seasons and changing weather patterns.

Invasive Plant Species*

- Many invasive plants have shallow root systems that provide limited erosion control, crowd out native plants and inhibit tree growth.

Erosion*

- Wind and erosion along rivers and creeks can cause significant destruction of property and infrastructure.
- The 2008 Erosion and Sediment Control Manual is a key reference for actions to be taken to mitigate erosion.

Volcanic Activity*

- Portland has been and could be affected by ash from Cascade volcanoes that would impair breathing, limit visibility and clog air filters, HVAC systems and water and sewer systems.

Completed Action Item ST Flood #12 - Provide staff to participate in flood fight trainings led by the Multnomah County Drainage District. The Multnomah County Drainage District maintains the 31 miles of dikes along the Columbia River.

***Indicates hazard was added in 2010.**

NHMP – A Useful Tool for All Bureaus

The NHMP outlines Portland's hazard vulnerability and the actions that can mitigate hazards. Bureau involvement in the process and their inclusion of action items into the NHMP qualifies actions for pre-disaster mitigation grant funding. The NHMP is a tool that all bureaus can use to identify shared mitigation opportunities.

The 2010 Natural Hazard Mitigation Plan (NHMP) process was a set of facilitated discussions between bureaus about their programs and mitigation efforts, resource capabilities and the ability to maximize their programs' effectiveness through collaboration. An example of collaboration is the development of a citywide landslide committee that meets to discuss landslide sites and actions taken by different bureaus to mitigate the impact of the landslide, provide information to the public and share engineering expertise. The NHMP process also allowed bureaus to understand how their ongoing projects mitigate hazards. The greatest finding this year was the identification of invasive plant species as a hazard that has a cascading affect on the environment if uncontrolled. Whereas indigenous plants have deep roots, greater fire resistance and do not stunt tree canopy growth, invasive plants do. We learned that by eradicating invasive plants we mitigate landslides, air pollution and wildland urban interface fire.

Resiliency Means to Bounce Back

Portland's NHMP is a five year, multi-bureau effort to strategically develop a more resilient city. The objective of this mitigation strategy is to coordinate bureau projects and resources to proactively maximize the protection of life, infrastructure, property and the environment. By investing in mitigation projects, the city decreases the risk and consequently the cost of disaster. In disaster our response resources will be stretched. Through prior planning and implementation of mitigation projects we decrease the amount of damage to our assets and will be able to use resources for the greatest response and rebuilding needs. The intent of this plan is to identify what can be done prior to disaster that will protect the most people, the most essential and critical infrastructure and the most natural resources to enable the continuation of services, livability and economic stability for the citizens.

Criteria Based Ranking

The Mitigation Planning Team identified criteria to identify the action that would have the greatest impact on the most hazards, meet the greatest number of goals, have the resources to implement current projects, and align with citywide and individual bureau priorities and goals. Table 1-3a lists the actions in order of the number of criteria met.

Table 1-3a Criteria Based Ranking of Action Items

ID	Description	Responsible Parties
ST= Short Term, **LT**= Long Term, **MH** = Multi-Hazard, **WF** = Wildland Urban Interface Fire		
STMH #1 19 pts	Continue to involve the public in updating the Natural Hazard Mitigation Plan.	All Bureaus
STMH #11 18 pts	Implement actions in the 2005 Portland Watershed Management Plan to help mitigate flood, landslide, earthquake and wildfire hazards.	Bureau of Environmental Services (BES)
STMH #13 17 pts	Coordinate emergency standard operating procedures and plans between disaster responder organizations in the Portland Metro region.	Portland Office of Emergency Management (POEM) Transportation (PBOT), Fire and Rescue, Emergency Communications, Police
LTMH #1 16 pts	Revise Portland's Comprehensive Plan to address and implement Citywide policies, land use improvements…mapping changes of natural hazards.	Planning and Sustainability (BPS); POEM
LTMH #14 16 pts (Reworded STMH#5)	Acquire (buy out), demolish or relocate structures from hazard prone areas. Property deeds shall be restricted for open space uses in perpetuity to keep people from rebuilding in hazard areas.	BPS, PBOT, BES, POEM,
STWF #14 16 pts	Convene a standing wildfire interface fire technical group.	Fire and Rescue, Parks and Recreation, BES, POEM
STMH #5 15 pts	Acquire Light Detection and Ranging (LIDAR) analysis of the Portland Metro area.	POEM, Corporate GIS, BES, Fire and Rescue, Water, PBOT
ST MH #7 15 pts	Create a mitigation mapping committee to index and maintain Geographic Information System (GIS) mapped inventory and develop prioritized list of critical facilities, residential and commercial buildings within known hazard areas.	POEM, Corporate GIS, BPS, BDS, Fire and Rescue, Water. PBOT, BES
ST MH #8 15 pts	Partner with utilities to ensure continuity of service to the City and the Columbia South Shore Well Field to provide for redundancy in case of primary power outage.	Water, BES
STMH #10 15 pts	Develop educational materials for residents that identify and define their risk to multi hazards.	POEM
STMH #9 14 pts	Develop a City employee emergency response plan to ensure that City employees understand expected actions so that essential services can continue.	POEM
LTMH #15 NEW 13 pts	Cross reference and incorporate mitigation planning provisions into all community planning processes such as comprehensive, capital improvement and land use plans to demonstrate multi-benefit considerations and strengthen eligibility for funding from multiple sources.	POEM, BPS, Fire and Rescue, PBOT, Water, BES

Successes

Since 2004, Portland has received three Pre-Disaster Mitigation Grants. The Bureau of Environmental Services, Portland Water Bureau, Portland Parks & Recreation and Portland Fire and Rescue have all been recipients and have worked toward mitigating flood, fire, earthquake and landslide hazards.

Bureau of Environmental Services (BES)
Johnson Creek East Lents Floodplain Restoration Project

Johnson Creek Floodplain

In 2006, BES received a $2,700,000 Pre-Disaster Mitigation Grant from FEMA to create the East Lents Floodplain Restoration Project. The 60-acre project will restore the historic floodplain along Johnson Creek. The project site is south of SE Foster Road from about SE 106th Avenue to SE 110th Drive and expected to be completed by 2011. This project will address flooding, habitat and water quality issues in the watershed. When complete, the project will add flood storage to the floodplain. To date, the City has spent over $8 million acquiring land in this area and $30 million in the Johnson Creek Watershed. In addition to the FEMA grant, the City has provided approximately $900,000 in funding.

Action Items in the 2010 Mitigation Plan relative to flooding include:

- Identify funding for the design and construction of the Springwater Wetlands complex, a 30-acre floodplain wetland restoration project in the Lents area of Johnson Creek.
- Complete update of the Johnson Creek Restoration Plan.
- As Waterfront Park remodeling is designed, ensure that Portland's downtown property and critical facilities remain protected from floodwaters.

January 2009 Flood - Lents

Portland Parks and Recreation, Fire and Rescue and the Bureau of Environmental Services

Portland Wildfire Fuel Reduction Project Wildfire Readiness Assessment & Gap Analysis

Powell Butte controlled burn

2006 funding provided by a FEMA Pre-Disaster Mitigation Grant enabled the City to educate residents about wildfires and work with volunteers, non-governmental agencies and local contractors to reduce hazardous wildfire fuels on public and private lands at the wildland urban interface. An interagency project team composed of staff from Portland Parks and Recreation, the Bureau of Environmental Services and Portland Fire and Rescue, a Technical Advisory Committee and three Citizen Advisory Committees prepared and implemented long term natural resource restoration plans and carried out fuel reduction projects in three focus areas: Forest Park, Powell Butte Nature Park and two segments of the Willamette Escarpment (Oaks Bottom and Mocks Crest).

To date, hazardous wildfire fuels have been treated on approximately 900 acres of public and private lands. On the ground work will continue for the duration of the grant, but additional risk reduction and interagency wildfire planning remains to be done. In 2009, the project team, with the assistance of consultants and the Technical Advisory Committee conducted a Citywide Wildfire Readiness Assessment to determine the ability of the City to cope with wildfires in and around Forest Park and Powell Butte. The findings of this assessment are documented in a report that details proposed actions to improve City preparedness for wildland fires. www.portlandonline.com/wildfire.
Action items in the 2010 NHMP include:

- Convene a standing City/County Wildfire Technical Working Group.
- Modify existing regulations to improve the permitting process and increase the defensible space around structures.

Portland Water Bureau
Conduit Trestle – Diack's and Sester's Ponds

800,000 people in the Portland metropolitan area depend on the Bull Run Watershed near Mt. Hood for drinking water. Three conduits and their related structures provide the primary supply line from the Bull Run watershed to the city.

The September 2000 System Vulnerability Assessment (SVA) Study recommended work to reduce the vulnerability of the conduits to multi-hazard risk from various hazards, including earthquakes, landslides, flooding and human error. This work involves multi-phase projects over the course of 10–20 years to increase the system's reliability.

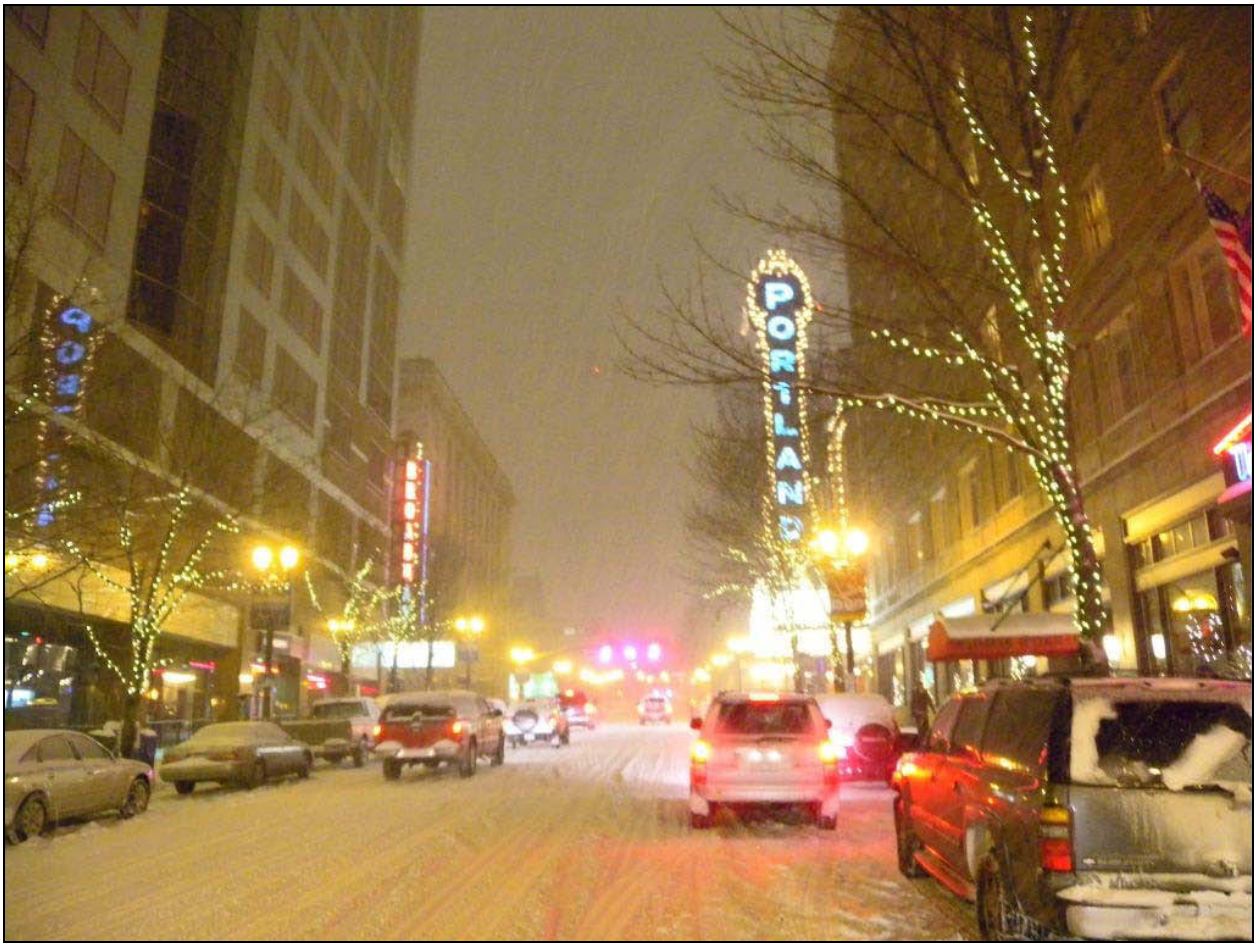
FEMA funding allowed for the upgrade of the conduit trestles at Diack's and Sester's Ponds where the water supply conduits cross stream channels on trestles. The primary goal is to minimize service outages and shorten restoration times for water service in future earth-quakes. At Diack's Pond, the existing non-engineered dam will be drained, the existing stream channel will be channeled into a box culvert and the piping will be hardened against scour by concrete encasement along with additional structural improvements. At Sester's Pond, the conduits will be relocated downstream of the dam, under the stream below scour depth and hardened with concrete encasement.

The grant award was for up to three million dollars with the City providing a match contribution of $1,054,000. The work on the Diack site began in April 2008 and at the Sester site in June 2008.

Actions within the 2010 NHMP relative to hardening infrastructure such as this are:

- Partner with utilities as they ensure continuity of service to the City and the Columbia South Shore Well Field to provide for redundancy in case of primary power outage.
- Assess the stability of levees in the Columbia Corridor Area and develop appropriate emergency plans to address potential levee failure and associated hazards.

Section 2 Community Description



2.1 LOCATION, GEOGRAPHY AND HISTORY

The city of Portland, with a population of 582,130 (July 1, 2009 Portland State Population Research Center), comprises an area of approximately 145 square miles in northwestern Oregon (134.3 sq mi of land and 11.1 sq mi of water) and sits at an elevation of 50 feet above sea level with hills extending higher than 1,000 feet. Located astride the Willamette River at its confluence with the Columbia River, Portland is the center of commerce, industry, transportation, finance and services for a metropolitan area of more than two million people. Portland is the largest city in Oregon, the seat of Multnomah County and the second largest city in the Pacific Northwest. It is located at approximately 45.52 North Latitude and -122.681944 West Longitude; 179 miles south of Seattle, Washington and 372 miles north of San Francisco, California.

The Columbia River Gorge lies to the east of the city, providing a break in the Cascade Mountain Range. Several large volcanoes are located close to the city, including Mt. St. Helens, Mt. Hood, Mt. Adams and Mt. Jefferson. Portland lies about 78 miles east of the Pacific Coast, bordered on the north by Clark County in the State of Washington, on the west, south and east by Washington, Clackamas and Hood River counties, respectively.

Figure 2-1a Map of Portland and Multnomah County

Portland, incorporated in 1851, is a home rule charter city. The City Charter is the basic law under which the City operates and can be amended only by a vote of the people. In 1913, a modified commission form of government was created, which is rare in cities as large as Portland. The City operates under the provisions of the City Charter and City Code, which are consistent with the Oregon Constitution and state law (the Oregon Revised Statutes).

Portland is in the marine west coast climate zone. Summers are warm and dry with clear skies, with July averaging 68.2 degrees Fahrenheit (°F). Winters can be mild to chilly and very moist, with January averaging 39.6 °F. The rainfall averages 36.3 inches per year. The city averages 152 days of measurable precipitation a year. Snow accumulations occur infrequently, however the city can experience major snow and ice storms as cold air patterns flow from the Columbia River Gorge. Winter snowfall totals range from negligible to an average of 6.5 inches with wind speeds averaging 7.9 miles per hour (mph). The city's lowest temperature was -2 °F on January 15, 1888; the highest temperature reached 107 °F on July 2, 1942, July 30, 1965 and August 8 and 10, 1981.

2.2 MINERALS AND SOILS

Several common natural hazards are related to soil stability and water retention and saturation. These hazards include landslides, erosion, flooding and liquefaction resulting from an earthquake. Mineral and soil compositions are important factors for determining whether Portland is prone to hazards such as landslides.

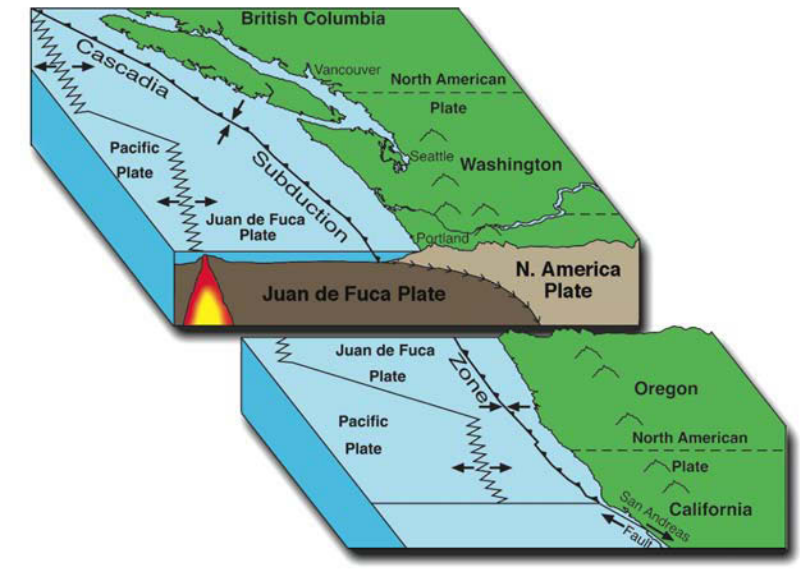
Soils on the west side of the Willamette River vary from clay loam with low permeability and relatively high erosion potential to gravelly loams, which are relatively well drained and moderately permeable. The flat areas along the west bank of the Willamette River are urban with highly disturbed soil and unstable fill.

On the east side of the Willamette River soils are highly variable, similar to the west side. Much of the area along the Columbia River has been filled with dredged sand, which drains very well. In undisturbed areas along the Columbia River, percolation (water flow through soil) rates are very slow. In the southeast areas of the city, soils vary from moderate to low permeability. In areas with well-draining soil, it is possible to manage storm water through infiltration practices.

2.3 SIGNIFICANT GEOLOGICAL FACTORS

Most of the Pacific Northwest lies within the Cascadia Subduction Zone (Figure 2-3a), where the Juan de Fuca and North American plates meet. The convergence of these tectonic plates puts most areas from western British Columbia to southern California at risk for a catastrophic earthquake with a potential magnitude of 9.0 or higher (Modified Mercalli Intensity Scale). Portland lies in this area of risk. There are the three crustal fault lines that run through Portland: the Portland fault, the East Bank fault and the Oatfield fault, each capable of generating moderately large (6.8) earthquakes. As a result of the subduction zone, there are active volcanoes nearby, including Mt. St. Helens in southwest Washington and Mt. Hood. Major eruptions of these volcanoes may cause significant ash fall in the Portland area.

Figure 2-3a Cascadia Subduction Zone



2.4 DEMOGRAPHICS

Table 2-4a Profile of Portland's Citizens

General Characteristics	2000	2007
City population	529,121	550,795
Male	261,565	270,567
Female	267,556	280,228
Median Age (years)	35.2	37.8
Under 5 years	32,000	35,401
25 years and older	363,106	389,821
65 years and older	61,163	55,595
Race/Ethnic Distribution		
One race		
White	412,241	431,419
Black or African American	35,115	35,002
American Indian & Alaskan Native	5,587	9,938
Asian	33,470	35,163
Native Hawaiian and other Pac. Is	1,993	2,896
Some other race	36,058	46,836
Two or more races		
Hispanic or Latino (of any race)	36,058	46,836
Household population	514,129	534,523
Total Housing Units	237,307	253,971

Source: US Census Bureau, 2007 American Community Survey

2.5 ECONOMY

Portland's economy has slowly diversified over the past decades. Steady growth in nontraditional sectors, such as the manufacture of electrical equipment, instruments and related products, has helped Portland's economy adapt to national and global trends. Semiconductor manufacturers, such as Intel and Wacker Siltronic, have established major facilities in the region. Tektronix, Nike, health systems Providence, Kaiser Permanente and Legacy, as well as retailers Safeway, Albertsons and Fred Meyer are some of the other major private sector employers in the Portland metropolitan area. Major public employers include Oregon Health and Science University (OHSU) and Portland State University.

The Port of Portland, the governmental unit responsible for air and marine port facilities, offers outstanding opportunities for expanding export industries, investments, business and travel. Portland's deep water location on the Columbia River gives it substantial geographic and economic advantages for freight shipping. The Columbia River shipping channel is maintained at a depth of 40 feet from the Portland harbor to the Pacific Ocean, 110 mile downstream. Portland is the largest wheat export port in the country. The Port also manages Portland International Airport (PDX). The airport is served by 14 passenger carriers providing more than 260 scheduled passenger flights daily to over 100 cities in the U.S. and Canada, as well as daily flights to Mexico, Germany and Japan. PDX is also served by 11 air-cargo carriers, including Air China, which provides nonstop cargo links to Asia.

Table 2-5a City of Portland Occupations

Occupations (figures indicate number of employees)	2000	2007
Management, professional and related occupations	102,760	120,718
Service occupations	41,444	45,348
Sales and office occupations	73,250	69,057
Farming, fishing and forestry	679	2,070
Construction, extraction and maintenance occupations	19,405	17,612
Production, transportation and material moving occupations	38,456	33,725
Median household income (dollars)*	$40,146	$47,143
Median family income (dollars)*	$50,271	$61,419

Source: US Census Bureau, 2007 American Community Survey
* adjusted for inflation

Section 3 Hazard Profiles

3.1 OVERVIEW OF HAZARD ANALYSIS

DMA 2000 Requirement – Risk Assessment: Identifying Hazards
Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the type of all natural hazards that can affect the jurisdiction. Refer to Appendix A, page 5.

A hazard analysis includes the identification, screening and profiling of each hazard. Hazard identification is the process of recognizing the natural events that threaten an area. Even though a particular hazard may not have occurred in recent history in an area, all natural hazards that may potentially affect the area are considered. Hazards that are unlikely to occur or where the accepted risk of damage is very low are eliminated from consideration. Human, technological and terrorism-related hazards are beyond the scope of this plan.
The following section describes hazards in terms of their nature, history, magnitude, frequency, location, extent and probability. Hazards were identified by collecting and reviewing historical plans, personal accounts of events and existing plans, studies and hazard maps for the city.

3.2 HAZARD IDENTIFICATION AND SCREENING

For the first step of the hazard analysis, the Planning Team reviewed the 2004 NHMP and determined that additional hazards should be identified to more accurately reflect current research. The team then evaluated and screened a list of nine potential hazards based on a range of factors, including the relative risk presented by each hazard, and the ability to mitigate the hazard (see Table 3-2a). The Planning Team determined that eight hazards pose a threat to the city. The five greatest hazards are: earthquake, flood, landslide, severe weather and wildland urban interface fire; along with three newly added hazards of erosion, volcanic activity and invasive plant species. The remaining hazard, tsunami, was excluded through the screening process and was considered to be nonexistent or to not pose a threat to life and property in the city due to the low likelihood of occurrence.

Portland Hills Fault, courtesy of DOGAMI

Table 3-2a Identification and Screening of Hazards

Natural Hazard	Should It Be Profiled?	Explanation
Earthquake	Yes	The city is located within the geographical area of the Cascadia Subduction Zone and lies on top of three crustal faults.
Severe Weather	Yes	Severe weather impacts the city with climate change/global warming and changing El Niño/La Niña Southern Oscillation (ENSO) patterns generating severe weather events such as winter storms, severe rain, thunderstorms and tornadoes with subsequent secondary hazards such as floods, landslides, snow and wind etc.
Flood	Yes	Historic and repetitive flooding has been identified as occurring throughout the city.
Landslide	Yes	The city is vulnerable to slope instability, especially after prolonged rainfalls. Much of the city lies within areas of unstable soil materials.
Tsunami	No	The city is located inland and is not subject to tsunami impacts, although the Columbia River is subject to tidal influences.
Erosion	Yes	Riverine, tributary and wind erosion occurs throughout the city in localized areas. The city is located inland and is not subject to coastal erosion.
Wildland Urban Interface Fire	Yes	The city's terrain, vegetation and regional weather conditions are favorable for wildfire ignition and rapid spread. Steep slopes and invasive plant species are contributing factors of rapid spread.
Invasive Plant Species	Yes	The city is experiencing increased numbers of terrestrial and aquatic invasive plant species. For example, the English Ivy and Purple Loosestrife are aggressive, invasive introduced species.
Volcanic Activity	Yes	The city is located in the vicinity of active volcanoes.

3.3 HAZARD PROFILE

DMA 2000 Requirements: Risk Assessment – Profiling Hazards

Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the 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. The requirements for hazard profiles, as stipulated in DMA 2000 and its implementing regulations are described below.

The Planning Team methodically examined and profiled selected hazards which potentially impact the city.

Each hazard's occurrence probability has an assigned rating (unlikely to highly likely) based on the criteria in Table 3-3a and its magnitude/severity (negligible to catastrophic) in Table 3-3b.

Table 3-3a Hazard Probability Criteria

Probability	Criteria
1 - Unlikely	Event is possible within the next 10 years. Event has up to 1 in 10 years chance of occurring (1/10=10%). History of events is less than or equal to 10 percent likely per year. Event is "Unlikely" but is possible of occurring.
2 - Possible	Event is probable within the next five years. Event has up to 1 in 5 years chance of occurring (1/5=20%). History of events is greater than 10 percent but less than or equal to 20 percent likely per year. Event could "Possibly" occur.
3 - Likely	Event is probable within the next three years. Event has up to 1 in 3 years chance of occurring (1/3=33%). History of events is greater than 20 percent but less than or equal to 33 percent likely per year. Event is "Likely" to occur.
4 - Highly Likely	Event is probable within the calendar year. Event has up to 1 in 1 year chance of occurring (1/1=100%). History of events is greater than 33 percent likely per year. Event is "Highly Likely" to occur.

Similar to estimating probability, magnitude and severity are determined based on historic events using the criteria identified above.

FEMA requires that the risk assessment identify the magnitude, severity and probability of future occurrence for each identified hazard. In several instances, there are industry standards associated with specific hazards (earthquake magnitude is described using the Modified Mercalli (MM) Intensity Scale and peak ground acceleration (PGA) and flood probability is predicted using 100 and 500 year flood zones). Many hazards however, do not have an industry standard or the industry standard may not currently and accurately describe the magnitude and severity or probability based on changing conditions (flood zones were mapped 30 years ago and flooding now occurs in different areas). For the purposes of describing magnitude and severity and probability of future occurrence in this hazard mitigation plan, the following criteria have been established.

Table 3-3b Hazard Magnitude/Severity Criteria

Magnitude / Severity	Criteria
1 - Negligible	Injuries and/or illnesses are treatable with first aid. Minor quality of life lost. Shutdown of critical facilities and services for 24 hours or less. Less than 10 percent of property is severely damaged.
2 - Limited	Injuries and/or illnesses do not result in permanent disability. Complete shutdown of critical facilities for more than one week. More than 10 percent of property is severely damaged.
3 - Critical	Injuries and/or illnesses result in permanent disability. Complete shutdown of critical facilities for at least two weeks. More than 25 percent of property is severely damaged.
4 - Catastrophic	Multiple deaths. Complete shutdown of facilities for 30 or more days. More than 50 percent of property is severely damaged.

3.3.1 Earthquake

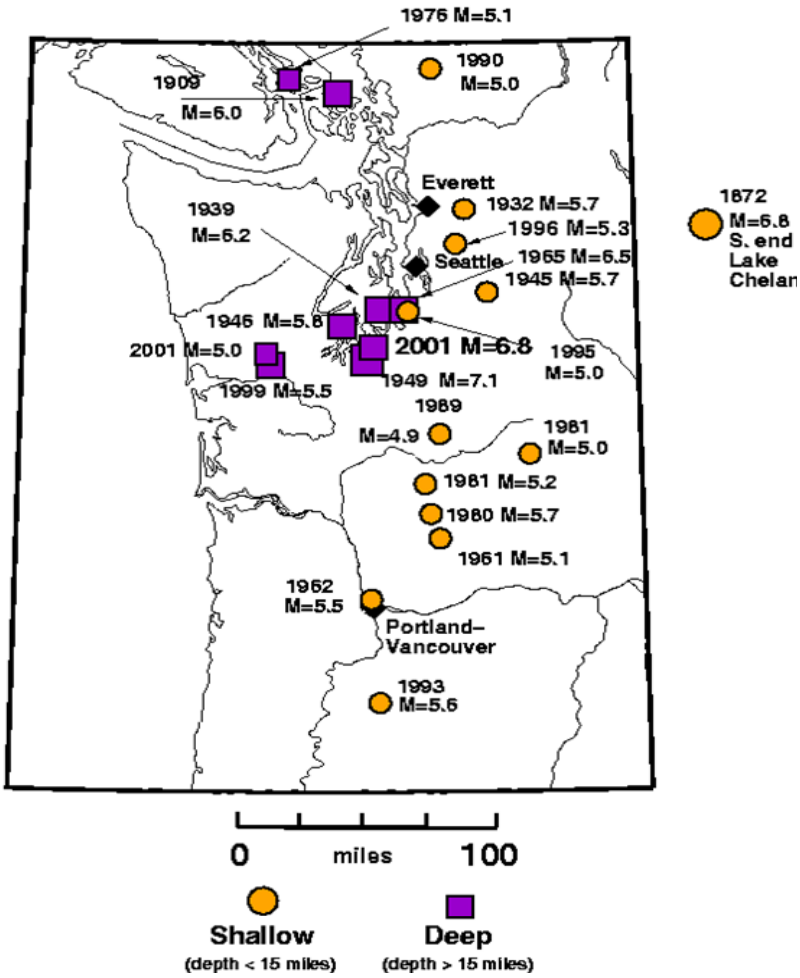
3.3.1.1 Nature

An earthquake is a sudden motion or trembling caused by a release of strain accumulated within or along the edge of the earth's tectonic plates. The effects of an earthquake can be felt far beyond the site of its occurrence. Earthquakes usually occur without warning and after only a few seconds can cause massive damage and extensive casualties. Earthquakes that occur in Oregon are crustal, intraplate or great subduction earthquakes.

Crustal earthquakes generally occur along shallow faults near the earth's surface. Crustal earthquakes make up the majority of earthquakes in the Cascadia area (Washington, Oregon and northern California) and are a result of fault movement in the earth's surface. These shallow earthquakes are usually less than magnitude 7.5 and strong shaking generally lasts 20 to 60 seconds. Aftershocks are anticipated after a crustal event.

Intraplate earthquakes occur deeper, at 20 to 40 miles beneath the ground surface. These deep earthquakes are usually less than magnitude 7.5 and damaging events occur every 10 to 30 years in this region. There are few aftershocks and tsunamis are generally not anticipated, although landslides can trigger localized seiche or tsunami like phenomena. Due to the deep earth movement, an intraplate earthquake is felt over a larger area but with less intensity. Damage from this type of event is generally less than with an equally sized crustal earthquake.

Figure 3.3.1a Significant Earthquakes Since 1872



Great subduction earthquakes occur offshore of the Oregon and Washington coasts along the Cascadia Subduction Zone. This zone is the result of the Juan de Fuca plate being pushed under the North American plate. Earthquakes centered along this zone can be as great as magnitude 9.0. Aftershocks of up to magnitude 7.0 are anticipated to cause additional damage. Liquefaction, tsunamis and landslides are expected as a result of a great subduction earthquake.

The most common effect of earthquakes is ground motion or the vibration or shaking of the ground during an earthquake.

Ground motion generally increases with the amount of energy released and decreases with distance from the fault or epicenter of the earthquake. An earthquake causes waves in the earth's interior (i.e., seismic waves) and along the earth's surface (i.e., surface waves). Two kinds of seismic waves occur: P (primary) waves are longitudinal or compressional waves similar in character to sound waves that cause back and forth oscillation along the direction of travel (vertical motion) and S (secondary) waves, also known as shear waves, are slower than P waves and cause structures to vibrate from side to side (horizontal motion). There are also two types of surface waves: Raleigh waves and Love waves. These waves travel more slowly and typically are significantly less damaging than seismic waves.

In addition to ground motion, several secondary natural hazards can occur from earthquakes such as:

Surface Faulting is the differential movement of two sides of a fault at the earth's surface. Displacement along faults, both in terms of length and width, varies but can be significant (e.g., up to 20 ft), as can the length of the surface rupture (e.g., up to 200 miles). Surface faulting can cause severe damage to linear structures, including railways, highways, pipelines and tunnels.

Liquefaction occurs when seismic waves pass through liquid saturated granular soil, distorting its granular structure and causing some of the empty spaces between granules to collapse. Water pressure may also increase sufficiently to cause the soil to behave like a fluid for a brief period and cause deformations. Liquefaction causes lateral spreads (horizontal movements of commonly 10 to 15 feet, but up to 100 feet), flow failures (massive flows of soil, typically hundreds of feet, but up to 12 miles) and loss of bearing strength (soil deformations causing structures to settle or tip). Liquefaction can cause severe damage to property.

Landslides/Debris Flows occur as a result of shock waves reverberating in sloped areas. The most common earthquake-induced landslides include shallow, disrupted landslides such as rock falls, rockslides and soil slides. Debris flows are created when surface soil on steep slopes becomes totally saturated with water. Once the soil liquefies, it loses the ability to hold together and can flow downhill at very high speeds, taking vegetation and/or structures with it. Slide risks increase after an earthquake during a wet winter.

Tsunamis occur when an Oceanic Plate is subducted beneath a Continental Plate. Eventually, too much stress is put on the lip of the Continental Plate and it snaps back, sending shockwaves through the earth's crust, causing a tremor under the sea, known as an undersea earthquake. Factors that affect tsunami generation from an earthquake event include magnitude (generally, a magnitude 7.5 and above), depth of event (a shallow marine event that displaces seafloor) and type of earthquake (thrust as opposed to strike-slip). The city has a "minimal" tsunami threat from either local or distant source events.

The severity of an earthquake can be expressed in terms of intensity and magnitude. Intensity is based on the damage and observed effects on people and the natural and built environment. It varies from place to place depending on the location with respect to the earthquake epicenter, which is the point on the earth's surface directly above where the earthquake occurred. The severity of intensity generally increases with the amount of energy released and decreases with distance from the fault or epicenter of the earthquake. The scale most often used in the US to measure intensity is the Modified Mercalli (MM) Intensity Scale. As shown in Table 3-3-1a, this scale consists of 12 increasing levels of intensity that range from imperceptible to catastrophic destruction. Peak ground acceleration (PGA) is also used to measure earthquake intensity by quantifying how hard the earth shakes in a given location. PGA can be measured as acceleration due to gravity (*g*).

Magnitude is the measure of the earthquake strength. It is related to the amount of seismic energy released at the earthquake's hypocenter, the actual location of the energy released inside the earth. It is based on the amplitude of the earthquake waves recorded on instruments, known as the Richter magnitude test scales, which have a common calibration.

Table 3-3-1a Magnitude/Intensity/Ground-Shaking Comparisons

Magnitude	Intensity	PGA (% *g*)	Perceived Shaking
0 – 4.3	I	<0.17	Not Felt
	II-III	0.17 – 1.4	Weak
4.3 – 4.8	IV	1.4 – 3.9	Light
	V	3.9 – 9.2	Moderate
4.8 – 6.2	VI	9.2 – 18	Strong
	VII	18 – 34	Very Strong
6.2 – 7.3	VIII	34 – 65	Severe
	IX	65 – 124	Violent
	X	124 +	Extreme
7.3 – 8.9	XI – XII		

3.3.1.2 History

Earthquakes listed as less than M 5.0 do not have a record of damage for the Portland area. The Mitigation Planning Team determined that significant quakes in the area were over M 5.0. Table 3-3-1b summarizes a list of historical earthquakes from 1980 to present which exceeded M 5.0 and were located within 100 miles of the preliminary determination of epicenter for the city.

Table 3-3-1b Historical Earthquakes for the City of Portland

Year	Depth (Miles)	Magnitude	Miles from Portland
1980	2.5	5.0	53
1980	3.1	5.0	60
1981	4.5	5.5	38
1989	11.2	5.1	82
1993	12.4	5.6	33.5

North America's strongest recorded earthquake occurred in Prince William Sound off the coast of Alaska on March 27, 1964, measuring M 9.2. Many Portland residents felt ground motion resulting from this historic event. However, no local damage occurred.

The largest recorded earthquake epicenter within 100 miles of Portland occurred in Scotts Mills on March 25, 1993, which measured M 5.6 and caused sporadic minor damage to buildings. The shaking was intense enough to require damage assessment team deployments to perform bridge and key infrastructure inspections. The average magnitude of all historic earthquakes is M 3.19 with an average distance of 52.4 miles from the city.

3.3.1.3 Location, Extent, Impact and Probability of Future Events

Location

The convergence of the Juan de Fuca and North American tectonic plates puts most areas of western Oregon and Washington at risk for a catastrophic earthquake with a Magnitude 9.0 or higher. Portland lies in this area of risk. The city also straddles three identified crustal faults that stretch the length of Portland: the Oatfield fault, west of the northwest hills; the East Bank fault, traversing the Willamette River into Oregon City; and the Portland Hills fault. The Portland Hills fault runs parallel to Forest Park into downtown Portland and could be capable of generating moderately large earthquakes. As a result of the subduction zone, there are active volcanoes nearby, including Mt. St. Helens in southwest Washington and Mt. Hood and Mt. Jefferson in Oregon. Major eruptions of these volcanoes could cause significant ash fall in the Portland area.

Liquefiable land is found predominately along the rivers of Portland. The city's industrial area, bridges, the Port of Portland (airport and marine terminals) and the newly established south and north waterfront developments along the Willamette River would be most affected because of their location on liquefiable soils.

Extent

Unreinforced masonry building debris from M 6.8 Nisqually Earthquake, 2001

The impact of a future earthquake depends on the type, magnitude and location of the quake. An earthquake can be anything from a tiny tremor affecting only a localized area, to a major shake that affects an entire region. Moderate local earthquakes will likely damage transportation routes including overpasses and bridges which span the Willamette and Columbia Rivers, water and sewer systems, natural gas and fuel lines and power/electrical systems. For hazard mitigation purposes, it should be assumed that the extent of a major event would be greater than citywide. Based on historic earthquake events and the criteria identified in Table 3-3b, the magnitude and severity of earthquake impacts in the city are considered critical where injuries and/or illnesses result in permanent disability, critical facilities are completely shut down for at least two weeks and more than 25 percent of transportation, infrastructure and the economy is severely damaged.

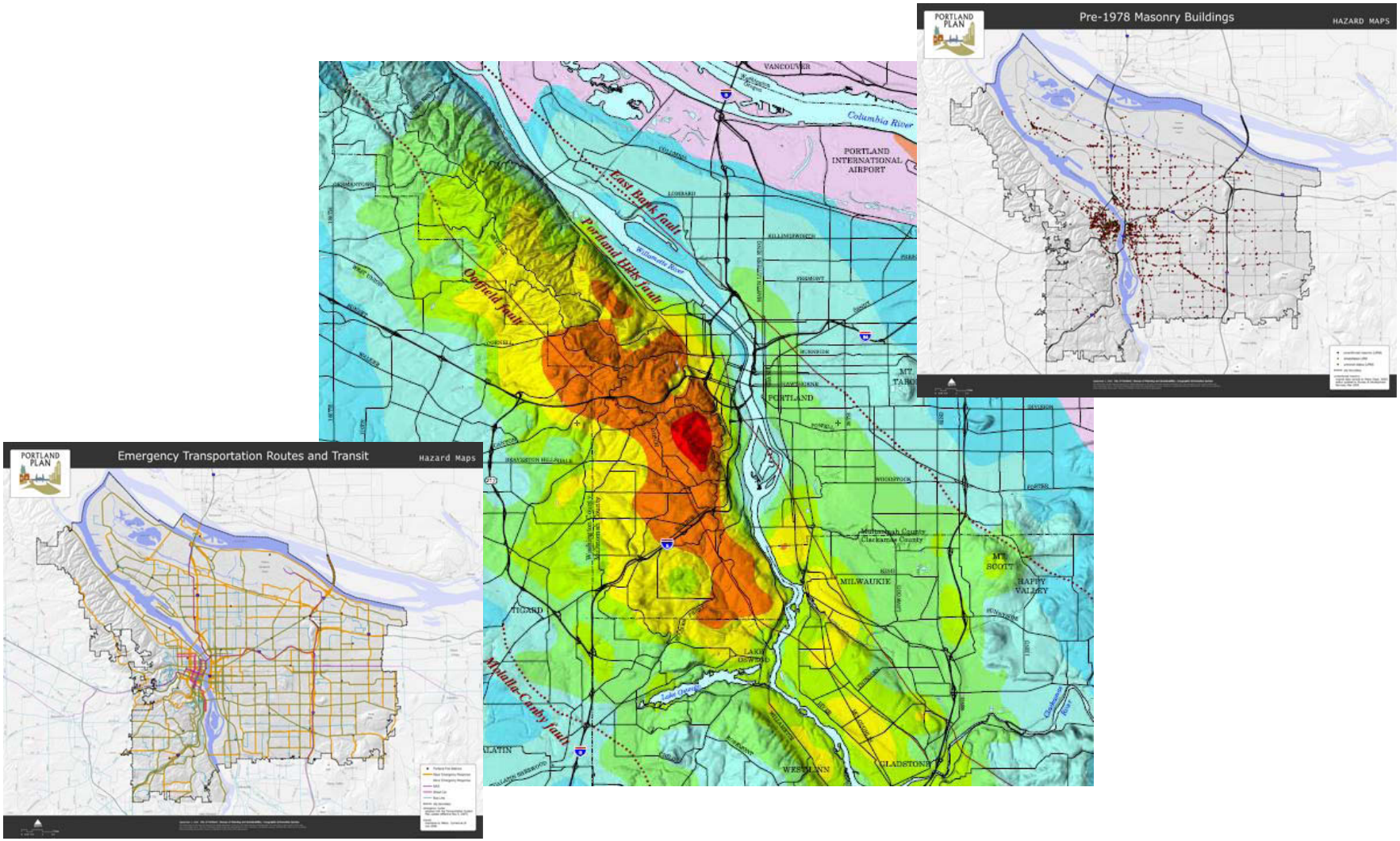
Impact

During strong ground shaking events, unreinforced masonry (URM) façade construction (found throughout the city) poses an extreme hazard, debris management and reconstruction concern. Most URMs in the downtown area are used for housing above storefronts. An analysis of the populations using these buildings is needed to determine the level of risk and therefore the impact on resources to care for the residents using and inhabiting them. The seismic structure of the buildings along emergency response routes such as found on Sandy, Martin Luther King, and Foster Boulevards needs to be conducted to determine the amount of debris that would need to be cleared and the populations impacted.

Regional transportation agencies developed an emergency response route map that represents agreed upon prioritized routes to be cleared of post earthquake debris. The routes will be assessed for damages first to determine emergency response vehicle connectivity to hospitals and other critical infrastructure.

The transportation system can be impacted by the collapse of underground pipes, tunnels, overpasses and damage to bridges. Secondary hazards such as landslide, fire, flooding and electrical outages can also impair the infrastructure system, not to mention posing safety hazards for those using them.

Figure 3-3-1b - DOGAMI's Portland Peak Ground Acceleration, Pre 1978 Unreinforced Masonry Buildings, Emergency Transportation and Transit Routes



Probability of Future Events

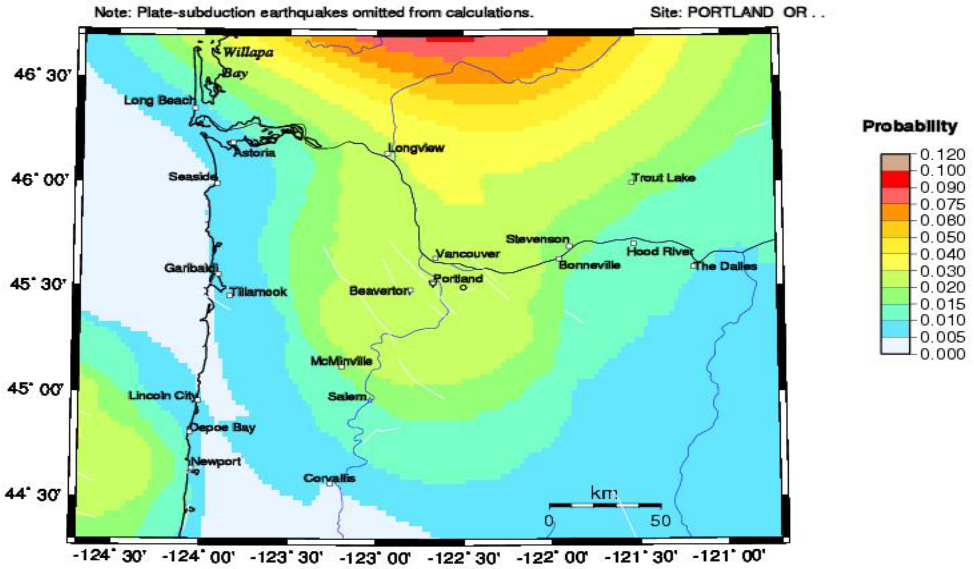
Recent research shows the Cascadia Subduction Zone is capable of producing a M 9.0 earthquake. The risk of damage to structures and human life is greater today because of the increase and concentration of population. Many older structures and utility infrastructures have experienced minimal impact from past earthquake events, but may remain susceptible to future, more intense events not designed to today's standards (Oregon Natural Hazard Workgroup [ONHW] 2004).

Geological evidence indicates that damaging earthquakes (M 8.0 to M 9.0) may have occurred at least seven times in the last 3,500 years, suggesting a reoccurrence of 300 to 600 years. We now know with the last Cascadia Subduction Zone great earthquake occurred on January 26, 1700. While it is impossible to predict when an earthquake may occur, it is highly probable (one event in 35 years) that a moderate earthquake (M 4.0 and greater) will occur along the Cascadia Subduction Zone, thereby affecting the city.

Portland's proximity to the Pacific coast (within 70-90 miles) makes a Cascadia-generated Subduction Zone earthquake a great concern to geologists. DOGAMI experts have stated that the probability of a subduction zone earthquake occurring is greater than those potentially generated by more localized faults.

The image here, generated using the USGS Earthquake Mapping model indicates an approximate 30 percent probability of a M 6.5 or greater earthquake occurring within 30 years and within 31 miles of the city.(http://eqint.cr.usgs.gov/eqprob/2002)

Figure 3-3-1e Portland Earthquake Probability



Probability of an earthquake with M ≥ 8.5 within 30 years and 50 km

The theoretical return period is the inverse of the probability that the event will be exceeded in any one year. For example, a 10-year event has a 1/10 = 0.1 or 10 percent chance, a 50-year has a 0.02 or 2 percent chance, a 100-year has a 0.01 or 1 percent chance and a 500-year earthquake event has a 0.002 or 0.2 percent chance of being exceeded in any one year.

3.3.2 Severe Weather

3.3.2.1 Nature

Climate change and El Niño/La Niña Southern Oscillation (ENSO) influences create increased weather volatility such as hotter summers (drought) and colder winters, intense thunderstorms, lightning, hail, snow storms, freezing rain/ice storms, high winds and tornadoes within and around the city.

ENSO is comprised of two weather phenomena known as El Niño and La Niña. While ENSO activities are not a hazard, they can lead to severe weather events and large-scale damage throughout Oregon's varied jurisdictions. Direct correlations were found linking ENSO events to severe weather across the Pacific Northwest, particularly drought, flooding and severe winter storms (Oregon 2004). Therefore, increased awareness and understanding of the impacts of ENSO events on regional weather are important.

TriMet, 2008 Winter Storm

Climate change is described as a phenomena of water vapor, carbon dioxide and other gases in the earth's atmosphere acting like a blanket over the earth, absorbing some of the heat of the sunlight-warmed surfaces instead of allowing it to escape into space. The more gasses, the thicker the blanket, the warmer the earth. Trees and other plants absorb carbon dioxide through photosynthesis. If there is not enough foliage carbon dioxide builds up and changes precipitation patterns, increased frequency and intensity of storms, wildfires, droughts and floods and substantial changes in habitats, including the range of pests and disease. The Climate Action Plan for the City of Portland outlines actions that can reduce carbon emissions and, through key objectives, mitigate the heating of the earth thereby reducing the impact of severe weather.

Table 3-3-2a Monthly Average Precipitation and Temperature

Month	Average High	Average Low	Record High	Record Low	Average Precipitation (inches)
January	45	34	65	-2	5.4
February	50	36	71	-3	4.1
March	56	39	83	19	3.7
April	61	42	93	29	2.5
May	68	48	100	29	2
June	73	53	102	39	1.6
July	80	57	107	43	0.5
August	79	57	107	44	0.9
September	74	52	105	34	1.6
October	64	46	92	26	3.1
November	52	40	73	13	5.5
December	46	36	65	6	6.5

Source: National Oceanographic and Atmospheric Administration

Snow Storms/Freezing Rain/Ice Storms

While snow is relatively rare in the lower elevations of western Oregon, the Columbia Gorge provides a low-level passage through the mountains. Cold air, which lies east of the Cascades, often moves westward through the Gorge and into the Portland area. If a wet Pacific storm happens to reach the area at the same time, larger than average snow events may result (Taylor and Hannan 1999). This situation may also result in ice storms. Like snow storms, ice storms are characterized by cold temperatures and moisture, but subtle changes can result in varying types of ice formation, including freezing rain, sleet and hail (NOAA 2001).

Ice and snow storms can be the most devastating of winter weather phenomena. Ice storms result in the accumulation of ice from freezing rain that coats every surface it falls on with a glaze of ice.

The resulting snow, ice or freezing rain poses danger from prolonged power outages (most lines are above ground), automobile accidents, transportation delays, dangerous walkways and direct damage to buildings, pipes, crops, other vegetation and livestock. Buildings and trees can often collapse under the weight of heavy snow.

High Winds

Wind is air flow that travels horizontally with respect to the Earth's surface and topography. High winds are defined as those that last longer than one hour at 40 mph or greater or wind gusts of 58 mph or greater. Wind speeds vary with individual storms. Windstorms often accompany snow, ice and extreme cold temperature during winter months (Wilde 2009).

64.4 mph winds downtown, June 2009

Most of the winds that come from the west are subdued by the time they reach the Portland area because of the influence of the Coast Range. The most destructive winds are those that blow from the south, parallel to the major mountain ranges. Some winds blow from the east, but most often do not carry the same destructive force as those from the Pacific Ocean. Severe storms affecting Portland with snow and ice typically originate in the Gulf of Alaska or in the central Pacific Ocean. These storms are most common from October through March (Land Conservation and Development Commission 2000).

Thunderstorms and Tornadoes

"Thunderstorms in the winter and spring are weak, producing small hail and brief gusty winds. Those in summer can produce prolific lightning, strong winds and large hail. Occasionally, thunderstorms will produce funnel clouds, but tornadoes are rare (National Weather Service 2009)."
Tornadoes are characterized by wind speed and duration. In general, the damaging effects of windstorms may extend for distances of 100 to 300 miles from the center of storm activity. Tornadoes are the most violent and destructive type of windstorm, usually caused by thunderstorms (Taylor and Hannan 1999). The low-pressure centers bring sustained winds (40-60 mph) strong enough to topple power lines and trees.

A tornado is a rotating column of air in contact with both a cloud base and the ground. Wind speeds can exceed 300 to 400 mph and can last between several minutes to several hours, leaving widespread destruction in their paths. The width of their paths vary between 10 feet and over one mile (ONHW 2004). While tornadoes are most common in the Midwest, they have occurred in Oregon and the state ranks 46th for tornado frequency (ONHW 2004). Multnomah County has experienced two tornadoes and three funnel clouds since 1957 (Wilde 2009).

3.3.2.2 History

The city is subject to severe weather pattern shifts. Several historic events have affected the city, such as severe thunderstorms, tornadoes and periods of below freezing temperatures.

Four lightning injuries have occurred in Multnomah County since 1995. Severe low temperature events occurred in 2004 and 2008 bursting water pipes and impairing travel.

A few of the most notable extreme weather events of the past decade include:

July 2009 Heat Wave. In the last week of July 2009, a historic heat wave occurred in Portland and broke several heat records for this area. This heat wave included the top two hottest three-day periods in Portland. July 2009 was also the second hottest month on record for Portland, with July 29 reaching 106 ºF, just one degree short of the record of 107 ºF set in July 30,1965 and on August 8 and 10, 1981 (Mooney 2009). July 2, 1942 reached 105 ºF.

December 2008 Winter Storm. Between December 14 and 26, 2008, the city experienced three major snowstorms that produced historically significant snowfall amounts. This series of winter storms has been described as one of the worst snow and severe weather events to affect the region in over 60 years.

The first two snowstorms produced between 3 to 6 inches across the region and the third snowstorm produced 11 to 16 inches of snow across Portland. The first storm hit on December 14th, the second on December 17 and the third and strongest snowstorm hit the region over a three-day period from December 20 to 22. In addition to the snow fall, an arctic air mass moved into the region on December 14th and persisted through December 26, 2008.

The city received 18.9 inches of snow (measured at the Portland NWS Office) by the end of December 2008. Historically, this was the snowiest December since 1940 when records began at the nearby Portland International Airport (Portland 2009e).

December 2003/January 2004, Winter Storm. From December 28, 2003 to January 14, 2004, a significant winter storm brought snowfall to most of Oregon. In early January 2004, the snow event turned into a major ice storm.

As rain reached the ground, it generally froze on contact with roads, cars and trees that had been chilled by the cold temperatures. Many trees were damaged or destroyed by large amounts of ice adhering to the branches. Downed power lines, often due to falling trees, caused power outages.

Several hundred flights were cancelled at the Portland International Airport beginning the evening of January 6, 2004. The light rail system also was shut down by the storm. For the first time, the Oregon Department of Transportation (ODOT) required travelers to chain up when traveling on any Portland metro area highway. Due to high winds, freezing rain and blowing snow, Interstate 84 was closed through Columbia Gorge on two separate occasions, for almost 70 hours total.

President Bush issued a major disaster declaration for 26 Oregon counties affected by the winter storm. The declaration was eventually extended to 30 of Oregon's 36 counties including Multnomah County (Oregon 2004a).

Table 3-3-2b lists the National Weather Service's major storm events for the city's Weather Zone. Each weather event may not have specifically impacted the city, but they were listed due to Portland's close proximity to listed communities or by location within the identified zone.

Table 3-3-2b Major Storm Events

Location or County	Date	Time (24hr)	Type	Magnitude
Multnomah	7/13/57	1900	Thunder Storm Wind	0 knots (kts)
Multnomah	3/23/58	1900	Thunder Storm Wind	0 kts.
Multnomah	4/5/72	1444	Thunder Storm Wind	63.3 miles per hour (mph)
Multnomah	4/5/72	1450	Tornado	F3
Multnomah	4/9/91	1530	Tornado	F0
Multnomah	7/31/91	2115	Hail	1.50 in.
Multnomah	11/12/91	1635	Tornado	F1
Multnomah	4/4/92	1900	Thunder Storm Wind	63.3 mph
Portland	6/9/94	1600	Wind Damage	N/A
Multnomah	1/1/95	0	Winds	N/A
Portland Intl Airport	3/9/95	1521	Thunder Storm Wind	78.2 mph
Mt. Tabor	3/9/95	1530	Thunder Storm Wind	96.7 mph
Portland Intl Airport	2/8/99	1708	Lightning	N/A
Portland	8/4/99	1920	Hail	0.75 in.
Portland	8/6/99	1730	Lightning	N/A
Portland	5/14/01	1600	Thunder Storm Wind/Hail	0 kts.
Multnomah	8/22/01	1000	Heavy Rain	N/A
Multnomah	2/22/02	2200	Heavy Rain	N/A
Multnomah	1/29/03	1200	Heavy Rain	N/A
Multnomah	3/7/03	0600	Heavy Rain	N/A
Multnomah	3/20/03	1000	Heavy Rain	N/A
Portland	5/17/03	1350	Funnel Cloud	N/A

Table 3-3-2b Major Storm Events

Location or County	Date	Time (24hr)	Type	Magnitude
Multnomah	12/12/03	1600	Heavy Rain	N/A
Portland	12/26/03 – 1/14/04	-	Winter Storm	N/A
Multnomah	1/27/04	0900	Heavy Rain	N/A
Multnomah	8/24/04	0800	Heavy Rain	N/A
Portland	3/8/06		Winter Storm	Latest historical winter storm
Portland Intl Airport	11/2/06	1200	Heavy Rain	N/A
Portland	1/2/07	2400	Heavy Rain	1.61 in.
Portland Intl Airport	5/2/07	1400	Hail	0.50 in.
Portland	7/12/07	2215	Thunder Storm Wind	57.5 mph
Portland	9/28/07	1420	Hail	0.50 in.
Portland Intl Airport	12/1/07	0600	Heavy Rain	N/A
Powellhurst	12/3/07	0230	Flood	N/A
Portland	12/14-26/08	13 day long	Winter Storm	50 yr high
Errol Heights	1/2/09	0630	Flood-Heavy Rain	1.3 in.
Portland	6/4/09	1615	Thunder Storm Wind	64.4 mph

Between the years of 1957 and 2009 there were four weather-related injuries; all occurred in Gresham due to lightning, three in 1995 and one in 1999. (NWS 2009)

3.3.2.3 Location, Extent, Impact and Probability of Future Events

Location

Portland can be affected by severe weather events originating in the central Pacific Ocean. Snow events can occur if a wet Pacific storm reaches the area when a cold air mass is present. Also, a natural break in the Cascade Mountains sometimes allows cold air from the east to funnel through the Columbia Gorge into the Portland area, which can eventually settle south to the Willamette Valley and thus create snow and ice events (ONHW 2004). Ice events include freezing rain, sleet and hail. Cold air rarely travels west of the Cascade Range, as the mountains provide a natural barrier separating the Willamette Valley from the cold air to the east.

Extent

Winter storm characteristics are determined by the amount and extent of ice and snow, air temperature, wind speed and wind direction. Emergency response times can be slowed because of icy road conditions and debris blocking road access. The weight of the snow or ice can cause utility disruption and falling trees and limbs. Snowmelt can cause flooding and landslides (ONHW 2004).

Winter Storm, 2008

High winds are likely to occur during the months of October through April. Destructive windstorms are less frequent, but recent research has revealed a connection between the neutral years of the ENSO conditions and major Pacific Northwest windstorms. Generally, windstorms have a short duration and winds move in a straight line with gusts exceeding 50 to 60 mph (Wilde 2009).

According to Table 3-3b the extent of severe weather events in the city is limited as injuries and/or illnesses do not result in permanent disability and a complete shutdown of critical facilities has never occurred. But it is possible that severe weather may last for more than one week and more than 10 percent of property could be severely damaged.

Impact

Climate change influences, weather intensity, community location and topography all shape the impact of severe weather on a community as well as influence future land use planning. Climate change impacts in the greater Portland Metropolitan area are mostly consis-tent with those expected in much of the Pacific Northwest. In the Pacific Northwest, tempera-ture and precipitation increased over the 20th century at a rate greater than the global value (Mote 2003). A temperature increase of 1.5˚F has been observed since 1920. Climate models project an average increase of about 6˚F by 2080 in this region, a rate almost three times the observed 20th century warming. Precipitation is also projected to increase, though less substantially than

temperature, at an average rate of 3.8 percent by 2080. The actual magnitude of these increases is dependent on future greenhouse gas emissions (Mote et al. 2005).
More frequent periods of drought due to climate change are of particular concern for the Pacific Northwest. This region relies on a robust winter snowpack for water storage for the summer months. Projected changes in temperature will likely reduce the winter snowpack and cause more snow to fall as rain, subsequently affecting April to September stream-flow. In the second half of the 20th century, April snow water equivalent (liquid water content of snowpack) declined more than 50 percent in the Portland area. Diminished summer water supply has consequences for drinking water supply, recreation, navigation, hydropower production and aquatic ecosystems among other uses (Mote 2003, Mote et al. 2005, USGCRP 2009).

Though streams in the summer months will be prone to low-flow situations, many of these systems are vulnerable to an increased flooding risk in the winter months. Flooding risk is greatest in systems where more wintertime precipitation will fall as rain rather than snow. Extreme precipitation (above the 95th percentile value) is projected to increase in the winter months and decrease in the summer months (Leung et al. 2004). Urban areas may be most at risk of wintertime flooding; small urban watersheds usually have large areas of impervious surfaces that are especially prone to flash flooding. Infrastructure in urban areas may also be designed using 20th century rainfall maps and may not be able to handle more extreme precipitation events (Leopold 1968, Rosenberg et al. 2009, Lowe et al. 2009).

Days with extreme heat are projected to increase in the 21st century. Heat waves (at least three continuous days) over 90 ˚F will occur more frequently in the 21st century. In particular, the elderly, urban-dwelling and those with chronic illness are most at risk to these extreme heat events (Jackson et al. 2009).

Additional secondary stressors that will exacerbate climate change impacts are projected increases in population growth and overall aging of the population (Jackson et al. 2009).

Probability of Future Events

Historical data shows that the probability for annual winter storm recurrence is high with a one-year recurrence interval. Winter storms combined with other weather events, like ENSO cycles, often result in compounded hazards area-wide. Winter storms have caused flooding, landslides, debris flows and utility and transportation systems disruptions.

Rainy commute on Interstate 5

The risk of experiencing a windstorm in the city is low. There is four percent probability of experiencing a 25-year event with winds of 60 mph. There is a two percent annual probability of experiencing a 50-year event with winds of 67 mph and a one percent annual probability of experiencing a 100-year event with winds of 75 mph (NWS 2006).

(one to two times every 10 years), storms of considerably greater magnitude can produce winds gusting up to 70 mph or greater. The typical windstorm pattern in this area is a southwesterly flow as air heads directly into the Pacific Northwest.

The preliminary research shows that El Niño events tend to shear weather systems apart as they approach the Northwest and La Niña events tend to have periods with enhanced high pressure, thereby producing enhanced cool, northerly flows. The wind-producing intervening neutral years tend to occur every three to seven years.

It is highly likely that a severe storm event will occur each calendar year (event has up to 1 in 1 = 100 percent chance of occurring) as the history of events is greater than 33 percent likely per year.

3.3.3 Flood

3.3.3.1 Nature

Flooding results when heavy or prolonged rain or snowmelt creates water flows that exceed the carrying capacity of river channels or other water courses and storage facilities. A flood can temporarily inundate normally dry land with water or mud.

SE 104th Avenue, Flood of 2009

According to FEMA's *Community Rating System (CRS) Communities and their Classes* resource document, the City is an active NFIP participant and has pursued CRS program participation since 2001 with a current rating of five. This rating earns NFIP policy holders a 25 percent discount in Special Flood Hazard Areas (SFHA) and a 5 percent discount in non-SFHA locations (Appendix H Reference: FEMA 2009). CRS is a program that promotes floodplain management actions that go beyond the minimum NFIP requirements. The program rewards these communities by discounting flood insurance premium rates.

Riverine flooding most frequently occurs from October through April. Air rises and cools over the Coast Range and its foothills and heavy rainfall develops over high-elevation streams, as storms move from the Pacific across the Oregon Coast Mountain Range. In this region, as much as four to six inches of rain can fall over a 24-hour period. Severe and prolonged storms can raise rivers and streams to their flood stages for three to four days or longer. (Appendix H Reference: ONHW 2004)

Flood damage can include:

- Inundation of structures.
- Erosion of stream banks, road embankments, foundations, footings for bridge piers and other features.
- Impact damage from high-velocity flow and from debris.
- Additional debris damage from accumulation on or blockage of infrastructure.
- Destruction of croplands.
- Release of sewage and hazardous or toxic materials from damaged pipelines, tanks and facilities.
- Economic loss (local facilities, utilities, communications, agriculture).

Characteristics of Flooding in Portland

Developed area flooding may occur when the amount of rainfall and runoff exceeds a storm water system's (creek, ditch, or storm drain) capability to remove it. Two types of flooding primarily affect Portland: *urban* flooding and *riverine* flooding. In addition, any low-lying area has the potential to flood. Urban flooding impacts related to ongoing stormwater drainage problems are not a significant issue in Portland because major overflows of the system are repaired immediately by the City's Maintenance Department. The 2008 Surface Stormwater Facility Maintenance and Management Manual guides this group's work.

Urban Flooding

Urbanization of the watershed changes the basin's hydrologic systems. As land is converted from fields or woodlands to roads and parking lots, it loses its ability to absorb and then slowly release rainfall. Heavy rainfall also collects and flows faster on impervious concrete and asphalt surfaces. Water moves to the ground and into streams at a much faster rate in urban areas. Adding these elements to the hydrological systems can result in floodwaters that rise very rapidly and peak with violent force. The resulting high water volume and turbidity both contribute to the erosion of stream banks.

A majority of land within Portland is urbanized and has a high concentration of impervious surfaces that either collect water or concentrate flow in unnatural channels. During periods of urban flooding, streets can become swift moving rivers and basements can fill with water. Storm drains and catch basins can also back up with vegetative debris and cause additional, localized flooding.

Numerous areas are currently subject to urban flooding and the number of at-risk areas could increase without proper infrastructure to guide water overflow. The continued increase of impervious surfaces related to development significantly contributes to Portland's future flood risk as increased runoff subsequently exceeds the capabilities of existing drainage infrastructure. Portland does not currently have a comprehensive policy regarding impervious surfaces in the 100-year floodplain or anywhere else. The Johnson Creek Plan District is the

only area in the city where the amount of allowed impervious surface is limited by the Zoning Code (Title 33 of the Portland City Code). This area was targeted because of the repeated flooding at severe levels. If other areas need to be targeted for Zoning Code limitations on the amount of impervious surface allowed the Bureau of Planning and Sustainability will address the concern.

Riverine Flooding

Riverine flooding – flooding that occurs along channels of rivers and streams – is the most common form of flooding in Portland. The natural processes of riverine flooding add sediment and nutrients to fertile floodplain areas. Flooding in large river systems typically results from large-scale weather systems that generate prolonged rainfall over a wide geographic area, causing floods in hundreds of smaller streams that drain into major rivers. Terrain helps determine the dynamics of riverine flooding. In relatively flat areas, shallow, slow-moving floodwater may cover the land for days or even weeks. In hilly, mountainous areas, a flood could begin only minutes after a heavy rain. Such a flash flood event provides no or short notice and can move so fast that it is particularly dangerous to people and property in the hills, on the slopes and at the base of the hills. Shallow area flooding is a special type of riverine flooding. FEMA defines shallow flood hazards in *"areas that are inundated by the 100-year flood with flood depths of only 1 to 3 feet*." These areas are generally flooded by low-velocity sheet flows of water.

3.3.3.2 History

Significant historic flooding has been recorded for both the Willamette and Columbia River basins in 1861, 1880, 1881, 1909, 1913, 1927, 1928, 1942, 1946, 1948, 1961, 1964/65, 1996 and 2007. Statewide floods in 1996 caused five deaths, forced thousands of people into shelters, destroyed hundreds of homes and caused damage in excess of $220 million. Portland was forced to erect makeshift barriers to prevent floodwaters from moving into the downtown area. Significant flooding also occurred in 2009 along local streams and flooded nearly 500 acres of Johnson Creek.

Homes lost in Vanport Flood of 1948

Flooding has greatly impacted Portland in the past and has the potential to do so in the future. One of the more severe flood years on record occurred in 1996, when many rivers and creeks throughout the Willamette River watershed rose to 100-year flood levels. On Friday, February 9, 1996, the Willamette River crested 10 feet 6 inches above flood stage; just inches away from testing the plywood wall built at Portland's downtown seawall. The Columbia River crested at 11 feet 2 inches above flood stage, testing the strength of the levees that protect Portland International Airport and areas north of Columbia Boulevard. Johnson Creek crested at 6 feet 5 inches above flood stage. Each year, there is about a one in 25 percent chance of a similar storm. A more serious storm could bring floodwaters over the downtown seawall and into the central business district.

- **May 1948.** Vanport was a small residential community located between the Portland city boundary and the Columbia River in 1943 and completely encircled with a dike system as Vanport's land mass was several feet below the Columbia River's normal water level. On Memorial Day 1948, the dike system was breeched resulting in a catastrophic flood. The city of 18,500 was flooded with "debris laden water" 10 to 20 feet deep. The majority of the buildings were either substantially damaged or destroyed. Fifteen people lost their lives. (Appendix H Reference: Flood 1948, Oregon 1998)

- **December 1964.** Nearly every river in Oregon exceeded its flood stage as weather stations set new records for precipitation. Known as the *Christmas Flood*, the event triggered debris flows, bridge failures and flooding that caused thousands to evacuate and closed airports, railways and hundreds of miles of roads across the state. Ultimately, the event caused more than $157 million in damages and 20 people were killed (Appendix H Reference: FEMA 2006).

- **February 1996.** Virtually every county in the State of Oregon received a disaster declaration due to a combination of warm temperatures, heavy snow pack and four days of record-breaking rain. Many areas had already received above-average rainfall, meaning rivers were at or reaching their capacities and flood stages. Recent logging activities contributed to increased runoff, resulting in atypical sediment and debris, which made conditions ripe for flooding and landslides. Hundreds of homes were destroyed, power outages were widespread, thousands were evacuated to public shelters and five people died. Some estimates of flood-related damages exceeded $1 billion. Later that same year in November, a tropical air mass swept across the state, once again bringing record-breaking precipitation. The stormy weather continued into December and early January as 26 major rivers reached flood stage. Snow melt and intense rain caused extensive flooding that led to widespread landslides, erosion, power outages, damaged homes and businesses, closed roads and eventually resulted in a Presidential Disaster Declaration (FEMA 2006).

  There were widespread road closures in Portland due to high water and landslides in several places. At the peak of the flood, all major highways were closed and those secondary roads that were open were restricted to emergency vehicles. FEMA disbursed repair and response totaling more than $5 million to public entities and the Oregon Economic Development Department funded nearly $1 million in Disaster Recovery

Flood East Lents, January 2009

Grants. Damages to private property were estimated at more than $5 million (Appendix H Reference: FEMA 2006).

- **December 2007.** Severe storms, winds, mudslides, landslides and flooding occurred between December 1 and 17, 2007 shutting down roads and highways including Interstate 5. Public infrastructure, homes and personal property were damaged. In Oregon, 73,000 residents were without power. A major disaster was declared for the State of Oregon on December 8, 2007 (Appendix H Reference: FEMA 2006) where river flooding was estimated at or above the 25-year stage.

- **January 2009.** Portland received 24-hour rainfall of 3.04 inches on January 1, 2009 caused by the "Pineapple Express". The great amount of snow accumulation in late December (15 inches to 3 foot drifts) and then the sudden warming at the beginning of January caused Johnson Creek to crest at 14.69 feet, with a flood stage of 11.0 feet. One hundred and eighty-seven flood loss claims were submitted to FEMA, six of which were repetitive loss, totaling $173,426. in the Portland area. This flood was ranked the third largest flood on Johnson Creek in terms of stream flow (2,430cubic feet per second [cfs]) and second highest in terms of stream level (14.69ft).

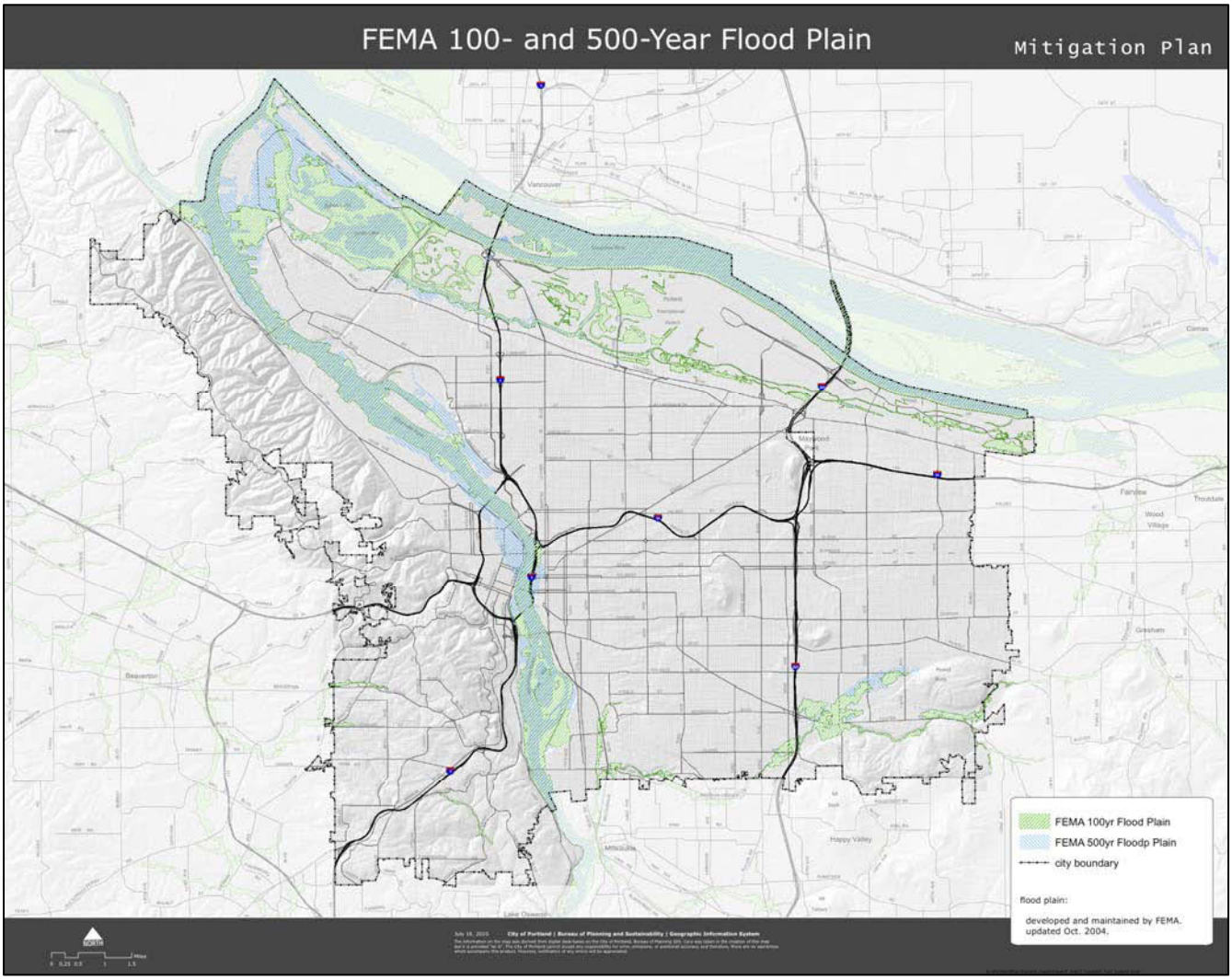
3.3.3.3 Location, Extent, Impact and Probability of Future Events

Location

The city is located in the Willamette River Basin, which spans approximately 11,460 square miles. The Willamette River Basin is the largest watershed in the state, with 13 major tributaries joining between its headwaters at Waldo Lake (southeast of Eugene) and the confluence of the Columbia River at Kelley Point. Though the city only occupies one percent of the Willamette River's drainage basin, its 17 square miles are the most urbanized and heavily used of all in the basin. Approximately 60 miles of ditches, the Columbia Slough and a series of smaller sloughs throughout and surrounding the city protect it from flood damage.

Johnson Creek flood near SE 72nd, 2009

Figure 3-3-3a City of Portland Flood Hazard Map



Extent

Portland is subject to flooding from river overflow from the Columbia, Willamette, Tualatin and Sandy Rivers, smaller rivers and lesser waterways as well as flooding from local storm water drainage. The city is susceptible to winter rain flooding between October and April, while between May and July snowmelt and runoff can create floods. Typically, the most severe floods are winter rainfall floods from December to February.

Floods are described in terms of their extent (including the horizontal area affected and the vertical depth of floodwaters) and the related probability of occurrence. Oregon's FEMA Flood Insurance Rate Maps (FIRMs) depict historical flood extent, defining most of the flood-prone streams delineating the 100- and 500-year flood events.

A 100-year flood (one percent probability) is used as the standard for floodplain management in the United States and is also referred to as a base flood. FIRMs prepared by FEMA provide the most readily available source of information for 100-year floods. These maps are used to support the NFIP. FIRMs delineate 100- and 500-year floodplain boundaries for identified flood hazards. These areas are State Flood Hazard Areas and provide the basis for flood insurance and floodplain management requirements. City of Portland uses 2004 FIRM maps. The mapped area of Portland, City/Multnomah and Clackamas Counties attributes the source of flooding as the Columbia and Willamette Rivers (FIRM data base 410183). As of November, 2010 new FIRM maps will be used for National Flood Insurance Program. The 100 year flood designation according to FEMA is entitled Special Flood Hazard Area. Within the Portland City limits there are 1,625 buildings in the Special Flood Hazard Area.

The city typically experiences flooding after more than three days of heavy rainfall or when saturated conditions combine with significant rainfall or storms over short periods of time. These conditions continually place the city's floodplain developments at risk with flood damage occurring on a regular basis throughout the city. Property losses resulting from flood damage can be extensive when faced with historic floods. The city has experienced more than $200 million in flood damage to both private and public property in the past three decades.

Based on past flood events and the criteria identified in Table 3-3a, the extent of flood impacts in the city's area is considered limited; injuries do not result in permanent disability, complete shutdown of critical facilities has never occurred but could occur for more than one week and more than 10 percent of property could be severely damaged.

Impact

Nationwide, floods result in more deaths than any other natural hazard. Physical damage from floods includes the following:

- Structure flood inundation, causing water damage to structural elements and contents.
- Erosion or scouring of stream banks, roadway embankments, foundations, footings for bridge piers and other features.

- Damage to structures, roads, bridges, culverts and other features from high-velocity flow and debris carried by floodwaters. Such debris may also accumulate on bridge piers and in culverts, increasing loads on these features or causing overtopping or backwater damages.
- Sewage and hazardous or toxic materials release as wastewater treatment plants or sewage lagoons are inundated, storage tanks are damaged and pipelines are severed.

Floods can also result in economic losses through business and government facility closure, utility (such as water and sewer) and transportation service disruptions. Floods result in excessive expenditures for emergency response and generally disrupt the normal function of a community. Impacts and problems also related to flooding include sediment deposition and stream bank erosion.

Deposition is the accumulation of soil, silt and other particles on a river bottom or delta. Deposition leads to the destruction of fish habitat and presents a challenge for navigational purposes. Deposition also reduces channel capacity, resulting in increased flooding or bank erosion. Stream bank erosion involves the removal of material from the stream bank. When bank erosion is excessive, it becomes a concern because it results in loss of streamside vegetation, loss of fish habitat and loss of land and property (Baker et al. 1988).

Probability of Future Events

The theoretical return period (reoccurrence) is the inverse of the probability that the event will be exceeded in any one year. A 100-year flood has a 0.01 or 1 percent chance of being exceeded in any one year and a 500-year flood has a 0.002 or 0.2 percent chance of being exceeded in any one year.

Flood studies often use historical records, such as stream flow gauge readings, to determine the probability of occurrence for floods of different magnitudes. The probability of occurrence is expressed as a percentage indicating the probability of a specific flood event occurring in any given year.

Factors contributing to the frequency and severity of riverine flooding include:

- Rainfall intensity and duration.
- Antecedent moisture conditions.
- Watershed conditions, including steepness of terrain, soil types, amount and type of vegetation and density of development.
- The existence of attenuating features in the watershed, including natural features such as wetlands and lakes and human-built features such as dams.
- The existence of flood control features, such as levees and flood control channels.
- Velocity of flow.
- Tide heights and storm surge.

- Availability of sediment for transport and the erodibility of the bed and banks of the watercourse.

These factors are evaluated using a hydrologic analysis to determine the probability that discharge of a certain size will occur and to determine the characteristics and depth of the flood resulting from that discharge.

The probability of an event occurring within this time period is highly likely; even though there can be a significant warning time (up to three hours for tributaries and possibly days for rivers), flooding can force facilities to shut down for up to 30 days or more. Based on previous occurrences and applying the criteria identified in Table 3-3a, it is probable that a flood has greater than a 33 percent likelihood of occurring in any given year.

Protecting Portland from Flood Losses

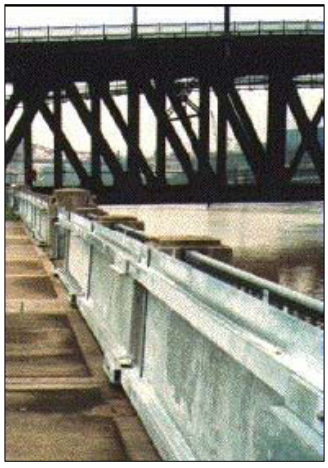
The Federal Flood Protection System that protects the managed floodplain along the Columbia River consists of approximately 60 miles of ditches. The Columbia Slough and a series of smaller sloughs protect the managed floodplain from flood damages. The ditches and sloughs were constructed and are maintained to accommodate a 100-year internal flood event. Storm water enters into these ditches and sloughs through a series of pipes that drain water from the streets and parking lots of Portland. Additionally, approximately 31 miles of levees protect the city from external flooding due to high water in the Columbia River and Lower Columbia Slough.

The system has been extensively improved since the 1996 flood. Pump station, levee and conveyance system upgrades – as well as a series of computers, repeaters and antennas that allow 24-hour real-time monitoring from remote locations – all make the system a very reliable means to protect the managed floodplain from catastrophic flooding. Continued management of the system insures future protection of the properties within the managed floodplain.

Flood control storage reservoirs have substantially reduced flood potential along the Columbia River and other major waterways. Upstream of Multnomah County, the Columbia River has 22 major reservoirs (representing 40 million acre-feet of flood storage) and the Willamette River has 11 major reservoirs (1.7 million acre-feet). These reservoirs have reduced, but not eliminated flood potential. Home and land purchase in the floodplain has decreased the loss of structures in the Johnson Creek area. Since Portland's first NHMP in 2004 the City has purchased 21.5 acres in the floodplain. Land acquired through this program helps qualify the City for additional flood mitigation points under the CRS program.

Floodplain restoration projects along Johnson Creek have also increased flood storage and helped to mitigate flood impacts. In 2006 the Bureau of Environmental Services received a $2.7 million Pre-Disaster Mitigation Grant from FEMA to create the East Lents Floodplain Restoration Project. The 60-acre project will restore historic floodplain and add flood storage along Johnson Creek. This project will address flooding, habitat and water quality issues in the watershed. To date Portland has spent over $8 million acquiring land in the area and $30 million total in the Johnson Creek Watershed. In addition to the FEMA grant project funding, the City of Portland is providing approximately $900,000 in matching funds.

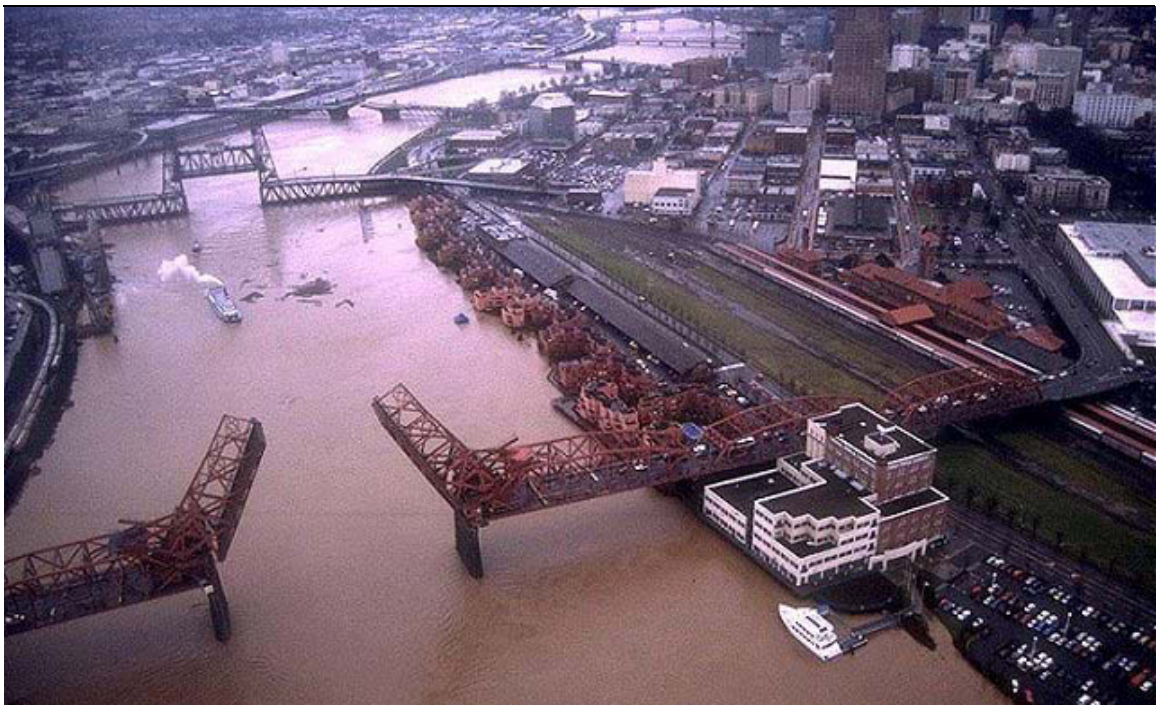
Land use can exacerbate flood impacts. Development and fill in the floodplain can push floodwaters into areas that did not formally flood or worsen the impacts within the floodplain. Development in the uplands can remove vegetation that naturally absorbs and attenuates stormwater and can create new impervious surfaces that shed excess stormwater toward flood prone areas. As a part of updating the Comprehensive Plan, Portland is updating it's buildable land inventory including flood prone hazard areas as part of their analysis.



Flood protection barrier

The purpose of Chapter 24.50.010 of the Portland City Code (Amended by ordinance November 2008) is to protect the public health, safety and welfare by restricting or prohibiting uses which are dangerous to health, safety, or property in times of flood or which cause increased flood heights or velocities and by requiring that uses and structures vulnerable to floods be protected from flood danger at the time of initial construction. The provisions of this Chapter regulate development and construction in flood hazard areas.

The Bureau of Environmental Services is currently updating the Johnson Creek Restoration Plan. The updated plan will provide a comprehensive set of actions focused on uplands, tributaries and drainage patterns to minimize the impacts of stormwater runoff on flooding. Implementation of these types of actions can help to improve the City's CRS ranking with FEMA.



Willamette River, 1996

3.3.4 Landslide

Landslides have created a number of problems in and around Portland's hills. Landslides result in private property damage, many impact transportation corridors, fuel and energy conduits and communication facilities. In October 2008, a devastating landslide destroyed two homes and severely compromised another three. There were no casualties from this event, but it displaced the families and shut down a transportation route for an extended period of time.

Landslides are a major geologic hazard in Oregon and the impact of landslides on property and life safety for Oregonians will only increase as population increases and development advances into more landslide-prone urban areas. For a typical year, an estimated $10 million is spent on landslide losses in Oregon (Oregon Department of Geology and Mineral Industries [DOGAMI] 2008).

3.3.4.1 Nature

Landslide is a general term for the dislodgment and fall of a mass of soil or rocks along a sloped surface or for the dislodged mass itself. The term is used for varying phenomena, including mudflows, mudslides, debris flows, mass wasting, rockfalls, rockslides, debris avalanches, debris slides and slump-earth flows. The susceptibility of hillside and mountainous areas to landslides depends on variations in geology, topography, vegetation and weather. Landslides may also be triggered or exacerbated by indiscriminate development of sloping ground or the creation of cut-and-fill slopes in areas of unstable or inadequately stable geologic conditions.

Additionally, landslides often occur with other natural hazards and human-caused activities, thereby exacerbating conditions, as described below:

- Earthquake shaking can trigger events ranging from rockfalls and topples to massive slides.
- Intense or prolonged precipitation can saturate slopes and cause failures leading to landslides.
- Landslides into a reservoir can indirectly compromise dam safety and a landslide can even affect the dam itself.
- Wildfires can remove vegetation from hillsides significantly increasing runoff and landslide potential.
- Construction projects accomplished without regard to geography, landslide toe locations, or historic slide events can increase landslide potential.
- Volcanic eruptions have been known to cause some of the largest landslides in the world.

Development and other human activities can also provoke landslides. Increased runoff, excavation in hillsides, shocks and vibrations from construction, non-engineered fill and changes in vegetation from fire, timber harvesting and land clearing can trigger landslide events. Broken underground water mains can also saturate soil and destabilize slopes, initiating slides. Something as simple as a blocked culvert can increase and alter water flow, thereby increasing

the potential for a landslide event in an area with high natural risk. Weathering and decomposition of geologic material and alterations in flow of surface or ground water can further increase the potential for landslides.
The USGS and DOGAMI have identified six landslide types, distinguished by material type and movement mechanism.

- **Slides:** The more accurate and restrictive use of the term landslide refers to a mass movement of material, originating from a discrete weakness area that slides from stable underlying material. A *rotational slide* occurs when there is movement along a concave surface; a *translational slide* originates from movement along a flat surface.
- **Debris flows:** Flows arise from saturated material that generally moves rapidly down a slope. A debris flow usually mobilizes from other types of landslide on a steep slope, then flows through confined channels, liquefying and gaining speed. Debris flows can travel at speeds of more than 35 mph for several miles. Other types of flows include debris avalanches, mudflows, creeps, earth flows and lahars.
- **Lateral Spreads:** This type of landslide generally occurs on gentle slope or flat terrain. Lateral spreads are characterized by liquefaction of fine-grained soils. The event is typically triggered by an earthquake or human-caused rapid ground motion.
- **Falls:** Falls are the free-fall movement of rocks and boulders detached from steep slopes or cliffs.
- **Topples:** Topples are rocks and boulders that rotate forward and may become falls.
- **Complex:** Any combination of landslide types (USGS 2004, DOGAMI 2008).

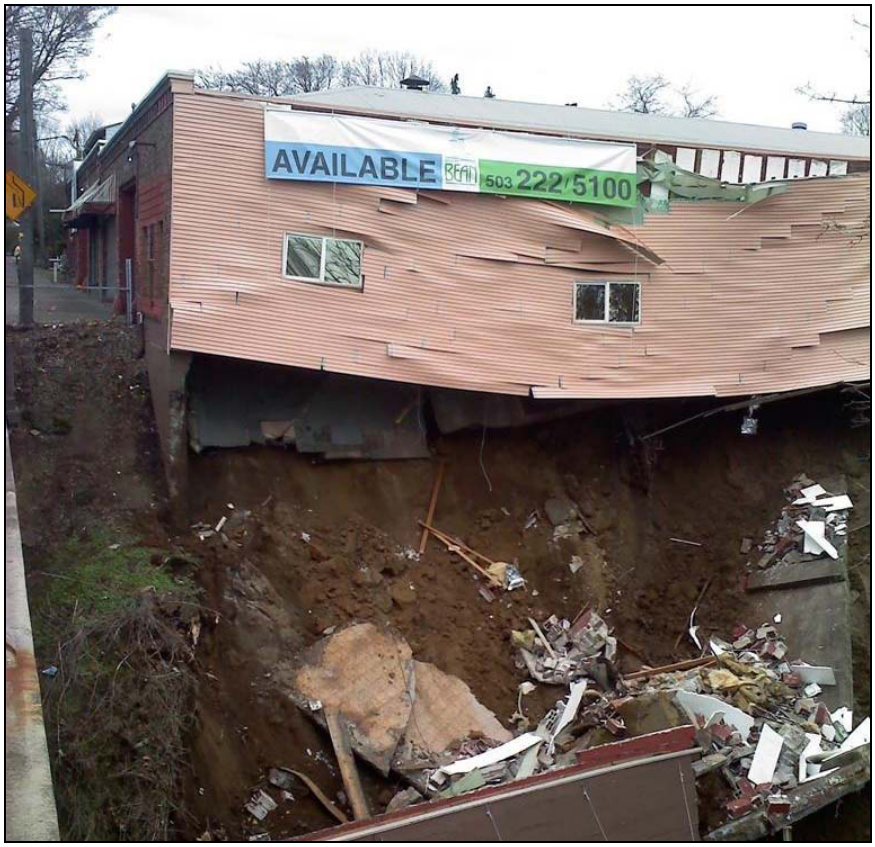
Indicators of a possible landslide include:

- Springs, seeps or wet ground that is not typically wet.
- New cracks or bulges in the ground or pavement.
- Soil subsiding from a foundation.
- Secondary structures (decks, patios) tilting or moving away from main structures.
- Broken water line or other underground utility.
- Leaning structures that were previously straight.
- Offset fence lines.
- Sunken or dropped-down road beds.
- Rapid increase in stream levels, sometimes with increased turbidity.
- Rapid decrease in stream levels even though it is raining or has recently stopped.
- Sticking doors and windows, visible spaces indicating frames out of plumb.

History

Landslides and debris flows are common in many parts of Oregon's northwest region. Much of the terrain is hilly and susceptible to slides; however, many slides take place in undeveloped areas and are unreported or even unnoticed. A statewide survey conducted by DOGAMI of winter storm landslides during 1996 and 1997 reported 9,582 documented slides. Historically, long periods of winter rain and heavy snowfall trigger landslides. These landslides may affect city roads and key emergency transportation routes.

Wildfires have removed vegetation from hillsides and significantly increased runoff and landslide potential. On the steep sloped Willamette Escarpment (Oaks Bottom and Mocks Crest Park natural areas) fires followed by repeated landslides have left many areas void of vegetation.



Landslide on NE 21st, 2009

Table 3-3-4a Historic Landslides

Date	Approximate Location or Type	Number of Occurrences
1895	Washington Park	1
1957	Children's Museum, World Forestry Center, Oregon Zoo	1
1972	I-5 near Portland	1
1996	Dodson, OR – Multnomah County	1
	February & December flood events. Portland Metro Area. Four main areas of concern: 1) West Hills 2) Steep slopes along Willamette River (i.e. Oaks Bottom, Swan Island) 3) SE Portland 4) Steep Areas along Columbia & north Willamette Rivers	700+
1996-2002	Portland (varied locations)	403
2005	Debris Flow – Mud Flow	1
	Earth Flow	2
	Mud Flow	1
	Slump – Debris Flow	1
	Slump – Earth Flow/Rock Fall	3
2006	Debris Slide	4
	Earth Flow	4
	Earth Flow – Debris Slide	2
	Earth Flow – Mud Flow	1
	Earth Flow – Rock Fall	1
	Rock Fall	1
	Slump – Debris Flow	1
	Slump – Earth Flow	1
	Slump – Earth Flow/Debris	1
	Type Unknown	1
2007	Debris Flow	3
	Debris Slide	3
	Earth Flow	4
	Flow	1
	Rock Fall	5
	Rock Fall – Earth Flow	1
	Slump – Earth Flow	2
	Slump – Debris Flow/Earth	1
	Slump – Earth Flow/Debris	1
	Slump – Earth Flow/Rock Fall	1

Table 3-3-4a Historic Landslides

Date	Approximate Location or Type	Number of Occurrences
2008	Debris Slide	3
	Debris Slide – Rock Fall	1
	Earth Flow	4
	Earth Flow – Debris Flow	3
	Earth Flow – Rock Fall	1
	Fault Scarp	1
	Potential Debris Flow	1
	Rock Fall	2
	Slump – Earth Flow	1
	Slump – Earth Flow/Rock Fall	3
	Type Unknown	2
2009	Debris Slide	4
	Debris Slide – Earth Flow	1
	Debris Slide – Mud Flow	2
	Earth Flow	2
	Earth Flow – Debris Flow	1
	Earth Flow – Mud Flow	1
	Earth Slide	1
	Possible Earth Flow	1
	Rock Fall	3
	Rock Fall – Mud Flow	1
	Slump – Debris Flow	1
	Slump – Earth Flow/Debris	1
	Slump – Earth Flow/Rock Fall	1
	Type Unknown	1

(Portland 2009)

Table 3-3-4b Portland Landslide Events: Impacted Highways (2004-2009)

Highway	Year	Type
US 26	2004 – present	Rock Fall/Rock Slide
	2006	Rock Fall
	2007	Rock Fall/Rock Slide
US 30	2009	Debris Flow
US 30 Bypass (N. Bridge Ave-North)	2008	Rock Fall
US 99W	2005	Soil Cut-Slope Failure (construction)
	2007	Rock Fall
	2008	Rock Fall
	2009	Soil Cut-Slope Failure (construction)

Snowstorm, NW Burnside, 2010

Table 3-3-4c City Landslide Repair Ordinances

Ordinance #	Date	Location	Repair Description
171227	1997	SW 27th Ave. Hillsdale Hwy	Hillsdale Community Center, Reconstruction of slides and replanting
171335	1996	SW Multnomah @ SW 48th	Slide repair
171336	1996	SW Multnomah @ 56th	Slide repair, Reconstruction of slides and replanting
171230	1996	W Burnside below NW Hermosa Blvd	Land movement repair
170824	1996	NW 81st Place	Retaining wall and slide repair
170697	1996	3229 NW Pittock Drive	Pittock Acres Park
173630	1999	W Burnside @ SW Tichner Drive	Unstable hillside, Acquisition of permanent easement
173626	1999	NW Raleigh Street	2 properties acquired – following 2/96 landslide, Landslide area stabilization and revegetation after buildings removed
173210	1998	Lakota – Saltzman Landslide Forest Park	Major Slide, Debris Removal
172014	1998	SW Fairview Blvd Below SW Champlain Drive	Threatened stability of Champlain – blocked sidewalk on Fairview, Debris removal – stabilization
172067	1998	SW Multnomah Blvd @ SW 61st	Street Closure, Debris removal
173013	1998	SW Capitol HW near SW Ralston Drive	Rock cliff slide, unstable roadway, Repairs and stabilization
173310	1998	W Burnside @ SW Tichner Drive	Slide, Intersection closed, larger slide occurred in January, 1999 during repair
Unknown	2008	SW Upper Hall	Rocks @ base
Unknown	2008	SW Spring Garden Road	Slope kick out/shoulder compromised
Unknown	2008	SW 18th and Broadleaf	Creek erosion
Unknown	2008	SW Beaverton Hillsdale Hwy	Slope failure

Source: Portland 2009. Exact addresses have been omitted to protect property owner privacy.

3.3.4.2 Location, Extent, Impact and Probability of Future Events

Location

In general, the probability of slope failure increases with an increase in slope inclination. However, depending on various factors such as soil type and water content, a slope having a relatively low inclination could be at greater risk of failure than another slope having a relatively high inclination. Other factors that influence susceptibility include: rock type, water content, vegetative cover and type, slope aspect, permeability and rate of infiltration, proximity to seismic sources and magnitude of seismic events. In addition, unconsolidated deposits of alluvial and glacial outwash materials are subject to accelerated stream bank erosion and landslides. The possibility of failure also increases in sloped areas in which humans have disturbed the soil and vegetation such as from cutback projects and timber reduction areas.

There are several data sets for Oregon and the City that identify existing landslide areas. These include DOGAMI SP-34 (landslide points from the 1996-1997 storms) and DOGAMI State Landslide Identification Database of Oregon (SLIDO) (landslide polygons from previous geologic and hazard mapping). Although these data sets exist, recent studies have shown that the use of light detection and ranging (LiDAR) to map landslides results is a significant improvement in our ability to locate historic and pre-historic landslides. In the first year of the use of this LiDAR data in Oregon, DOGAMI compared landslide mapping using existing techniques (time-series air photo survey and three other remote sensing types of data sets) to mapping with LiDAR in the Portland Hills. The LiDAR reveals many more slides and allows spatially accurate delineation of slide boundaries. Oregon City is the first city in the state to have one of these new landslide maps that was created by DOGAMI using the LiDAR technology (Burns and Madin 2008). The City of Portland has been working with DOGAMI to create such maps which are now in the process of review.

Extent

The Oregon Department of Forestry (ODF) conducted a three-year study of the impacts of landslides for the 1996 winter storms, entitled, *Storm Impacts and Landslides of 1996: Final Report*. The ODF study included eight study areas, but did not provide a detailed inventory of landslide prone areas outside of the very small study area. This study concluded that the highest hazard for shallow rapid landslides in western Oregon occurs on slopes of over 70 percent to 80 percent steepness (depending on landform and geology).

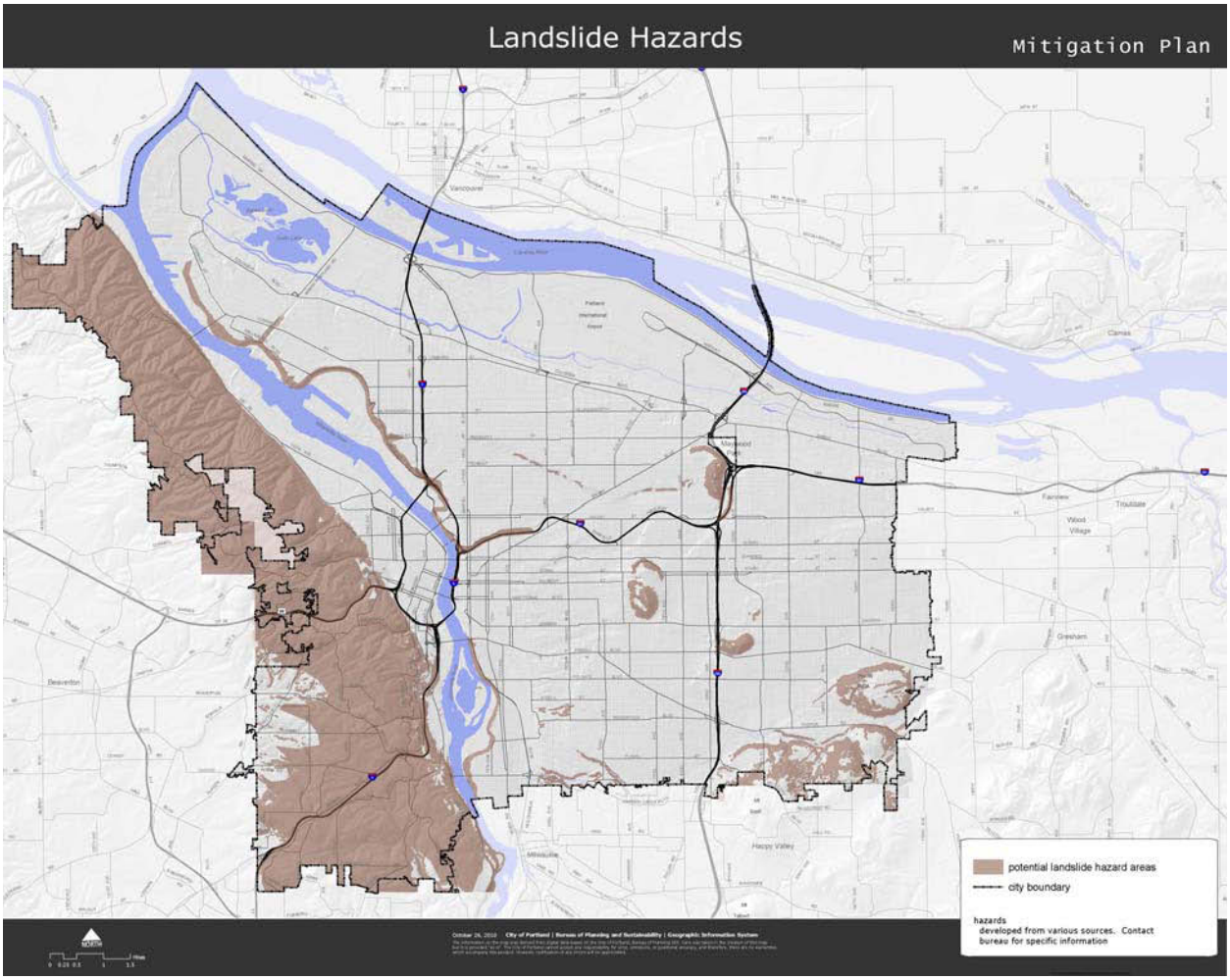
The geographic extent of landslide events is essentially the same as slide location, while the effects depend on what infrastructure is in the way of a slide, as well as the magnitude and force of the slide itself. The extent could be as limited as one building or property, to region-wide, as in the case of a major transportation disruption, slide-induced dam failure or utility outage.

Rapidly moving landslides have the greatest potential to endanger human life or inflict serious injury, especially to those living in or traveling through rapidly moving slide prone areas. Slow

moving slides are less likely to inflict serious human injuries, but can cause property damage (ONHW 2004).

Using the criteria identified in Table 3-3b, the extent of landslide impacts in the city are considered limited. An event may cause injuries and/or illnesses that do not result in permanent disability, there has never been an event that has completely shut down critical facilities for more than one week and an event with more than 10 percent of property severely damaged has also not occurred.

Figure 3-3-4a Landslide Areas and City Owned Properties



The landslide hazard is highlighted in brown.

Impact

Landslide events can cause fatalities, injuries and public and private financial losses to communities in direct and indirect ways. Real estate values can fluctuate and direct costs can be incurred in an effort to prevent or mitigate landslide events. Landslides can destroy all types of buildings and infrastructure. Landslides can block roads, knock out or damage power and other types of transmission lines. Landslide events can also strip forest cover or deposit additional sediment in stream channels which could potentially change channels and block stream passages thereby damaging or destroying habitats.

The impact of landslides on property owners starts at the first moment of investigation into a property with or without a house. Disclosure statements on property, permits requested for nearby land related projects, analysis of the existing structures for signs of land settling are all part of the evaluation process. Landslide mapping and smart development are important to the mitigation of landslides.

Highway 26 landslide, 2010

Probability of Future Events

Based on the criteria identified in Table 3-3a, the probability of landslide impacts in the city are considered highly likely. An event has up to a 100% chance of occurring within any year.

Landslides are an annual occurrence in Oregon during the rainy months, October through May. They generally result from intense or prolonged rainfall, particularly during a rain on snow event. Slope alteration and shape can also be a recurrence interval factor. Recurrence intervals for steep terrain can range from 50-5,000 years, with some debris flow recurrence intervals of less than 10 years (Appendix H Reference: Oregon 2004). Several steep sloped natural areas are prone to yearly landslides: Forest Park, Terwilliger Wildlands, Marquam Nature Park in west Portland and the Willamette Escarpment east of the Willamette River are notable.

3.3.5 Erosion

3.3.5.1 Nature

The city experiences annual rain and wind events that impact river shorelines combined with landslides and debris flows within the watersheds, loss of plant cover in riparian areas and river traffic induced erosion. During severe storm events Riverine erosion is magnified due to increase volume and velocity of the water flow. Erosion is a problem in developed areas where the disappearing land threatens development and infrastructure. There are two main types of erosion that affect human activity in Portland.

- Riverine erosion results from the force of flowing water in and adjacent to river, creek and tributary channels. This erosion affects the bed and banks of the channel and can alter or preclude any channel navigation or embankment development. In less stable braided channel reaches, erosion and material deposition are a constant issue. In more stable meandering channels, episodes of erosion may only occur occasionally.
- Wind erosion occurs when wind removes, moves and re-deposits soil. It can cause a loss of topsoil, hindering agricultural production. Blowing dust can also reduce visibility and have a negative effect on air quality.

Runoff from rain cuts rills (channels) and gullies, while wind can strip soil from wide areas. Both types of erosion can move large amounts of sediment, sometimes far from the original site of soil disturbance.

Four main factors influence erosion:

- **Soil erodibility:** Fine soils, impermeable soils and soils lacking organic material tend to be more erodible.
- **Vegetative cover:** Vegetation shields soil from rainfall and wind, increases infiltration, slows runoff velocities and retains soil moisture for later plant use between rainstorms.
- **Topography:** Long, steep slopes increase runoff amounts and velocities and therefore tend to increase erosion.
- **Weather:** The frequency, intensity and duration of rainfall influence sediment release amounts. Sediment from disturbed soils can move into neighboring properties, streets, drainage systems and other bodies of water. Excessive sediment damages the functions of both stormwater sewers and natural watersheds (Portland 2008b).

The City has identified riverine erosion areas along its rivers, creeks and tributaries. Erosion of any type rarely causes death or injury. However, erosion can cause significant destruction to property and infrastructure.

Generally, erosion occurs when the flow of the river changes and is directed towards the banks or mid-channel islands. These changes can be caused by surface wind stress and gravity waves

that occur during storm events (primarily severe winter storms) transporting sediment by bottom currents (Sternberg 1986).

Portland has instituted requirements for developers and landscape architects to design vegetative swales into parking areas and adjacent commercial developments to ensure enhanced water absorption. Great efforts are underway to prevent water entering storm drains with direct access to the city's rivers and streams. Swales filter contaminates prior to returning to the waterways.

The 2005 Watershed Management Plan, written by and coordinated through the Portland Bureau of Environmental Services, works to improve Portland's five watersheds stream quality (Figure 3-3-5b). This includes bank restoration and mitigation projects that prevent erosion.

Potential landslide and erosion area created by Willamette Bluff fire, 2001

3.3.5.2 History

The following descriptions provide a brief overview of historic erosion events in the city.

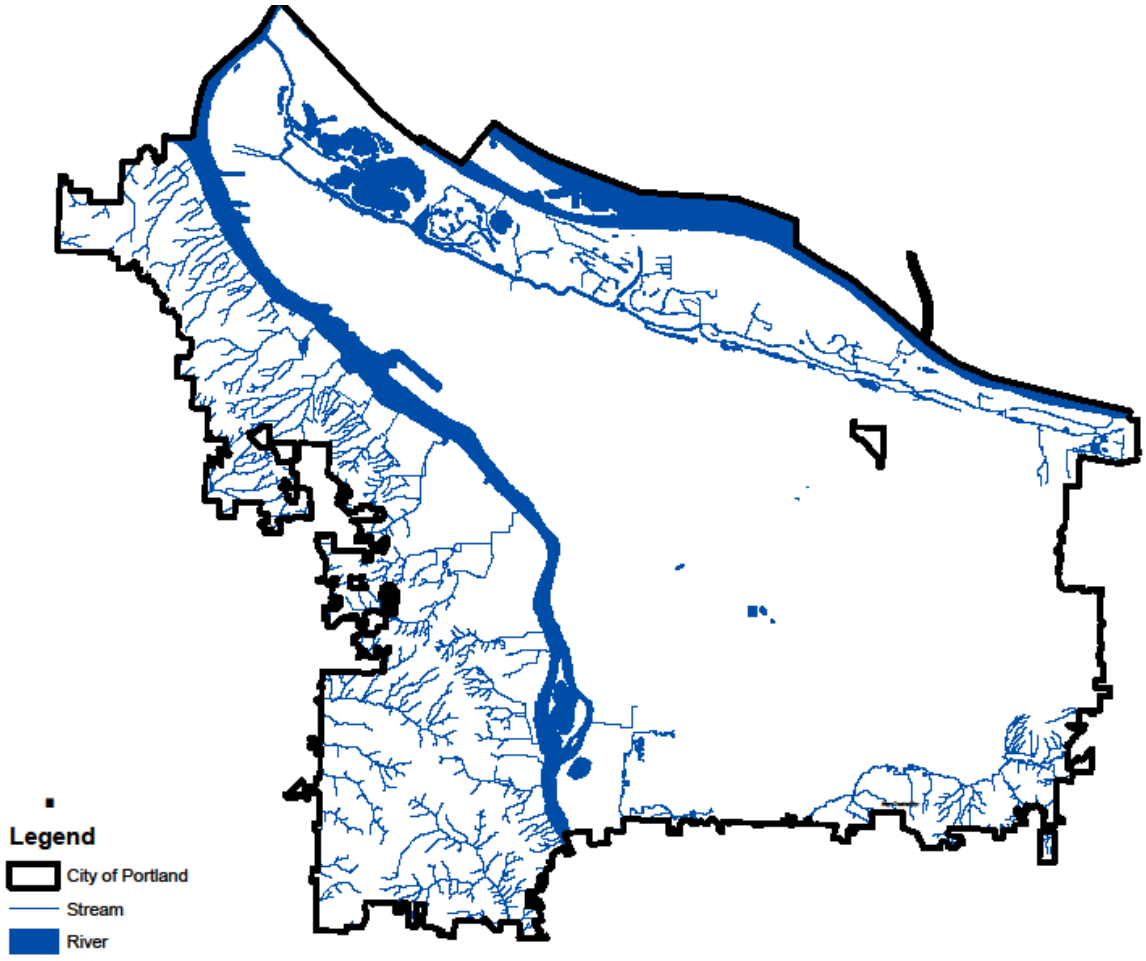
- Riverine erosion in local creeks occurred with minimal damage as culverts were filled and backed-up during the 1964 flood event.
- Wildfires in 2000 and 2001 removed vegetation that had stabilized hillsides. Subsequent erosion damage occurred during rain and snowmelt runoff events.
- Severe weather brings snow, rain and wind impacts to the city. Historical severe weather events surpassed the soil and the built environment's capacity to absorb or manage run-off, which results in erosion damages.
- Erosion occurrences are typically secondary events that are directly linked to other hazard events such as those identified in the following hazards profiles: flood (section 3.3.1), severe weather (section 3.3.2), landslide (section 3.3.4) and wildland urban interface fire (section 3.3.6) events.

3.3.5.3 Location, Extent, Impact and Probability of Future Events

Location

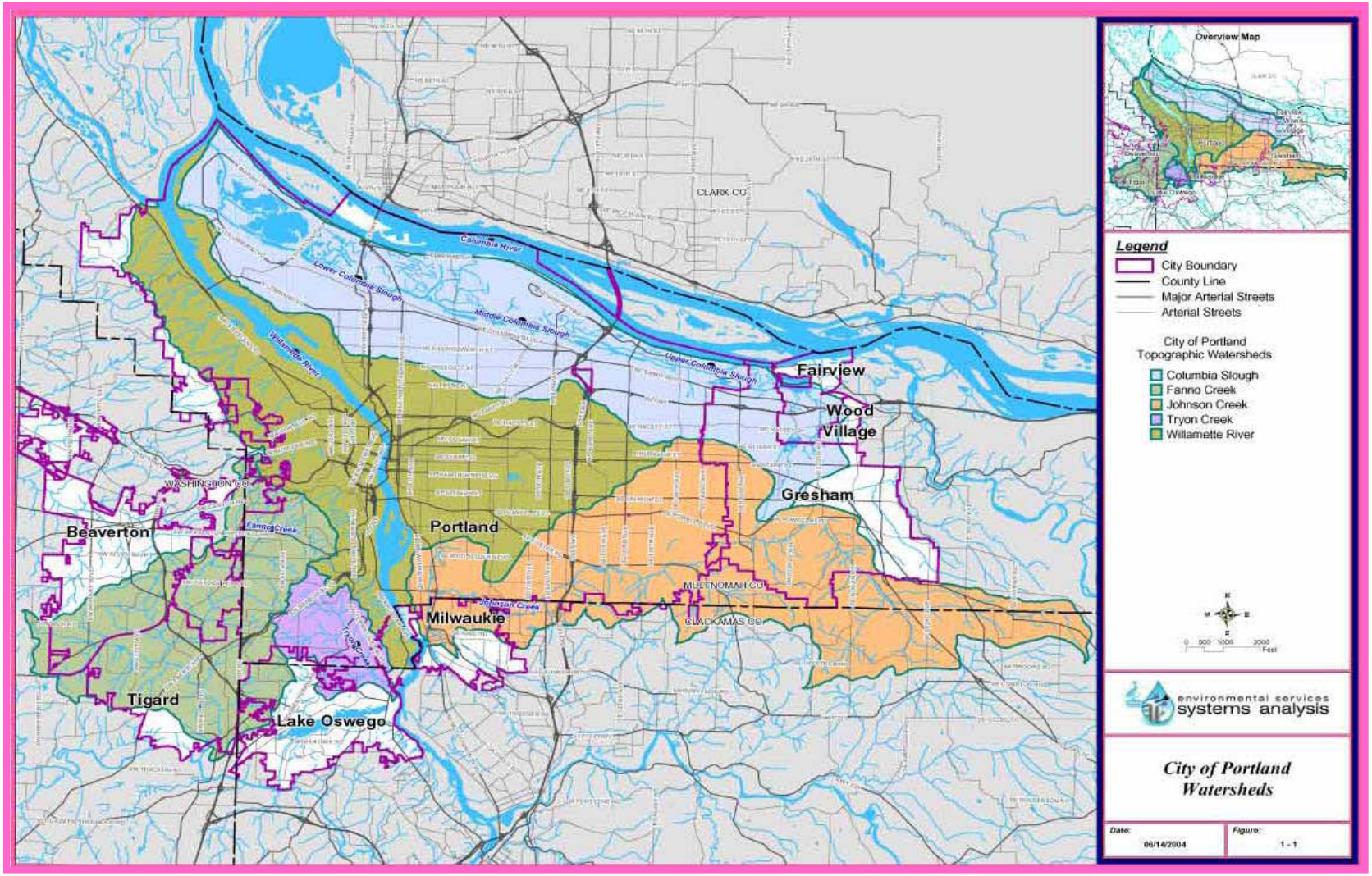
Portland has many streams flowing down canyons in its hilly terrain. The intensity of the flow in the streams during the rainy season causes erosion to the banks. Figure 3-3-5a shows the areas of concern for erosion and ultimately, sensitive landslide areas where the intense streams flows are coupled with steep slopes. All stream and river banks are vulnerable to erosion.

Figure 3-3-5a City of Portland River and Stream Map (Portland 2009h)



All rivers and creeks are subject to erosion. The city has two rivers and multiple streams and creeks. Some of those streams and rivers that are potentially threatened by erosion include: the Columbia and Willamette Rivers, Johnson, Tryon and Fanno Creeks; and the Columbia Slough. Hillside creeks are subject to erosion as a result of runoff caused by rain or melting snow pack.

Figure 3-3-5b City of Portland Watersheds



Extent

A variety of natural and human-induced factors influence the erosion process within the community. River orientation and proximity to up and downstream river bends can influence erosion rates. Embankment (earth or rock piled to keep back water or support a road) composition also influences erosion rates, (sand and silt will erode easily, whereas boulders or large rocks are more erosion resistant). Other factors that may influence riverine erosion include:

- Geomorphology (the study of land formation).
- Amount of encroachment in the high hazard zone.
- Proximity to erosion inducing structures
- Nature of the topography.
- Density of development.
- Structure types along the embankment.
- Embankment elevation.

SW Spring Garden Road, 2007

Rivers constantly alter their courses, changing shape and depth, trying to find a balance between the sediment transport capacity of the water and the sediment supply. This process, called riverine erosion, is usually seen as the wearing away of the watercourse's banks and beds over a long time period.

Riverine erosion rarely causes death or injury. However, erosion causes significant destruction of property, development and infrastructure.

Landslides, debris flow scour, embankment failure, or heavy rainfall are often initiated by riverine erosion. These processes generate high volume and velocity run-off that will concentrate in the lower drainages within a river's catchment area. When the stress applied by these flows exceeds the resistance of the embankment material, erosion will occur. As the sediment load increases, fast-flowing waters will erode their banks downstream. Eventually, the river, creek, or tributary becomes overloaded or velocity is reduced, leading to the deposition of sediment further downstream or in dams and reservoirs. The deposition may eventually lead to the watercourse developing a new channel.

While all rivers change in the long-term, short-term change rates vary significantly. All rivers can be categorized based on their ability to adjust their shape and gradient as either bedrock or alluvial channels.

The erosion rate depends on the sediment supply and amount of run-off reaching the watercourse. These variables are affected by many factors including earthquakes, floods, climatic changes, loss of bank vegetation, urbanization and the civil works construction projects in the waterway.

Erosion along the banks of the rivers and streams in the city is generally caused by a combination of factors; the natural process of a watercourse to find the path of least resistance; debris flows within the watershed; loss of riparian area plant cover; logging, wildfires, increased boat traffic close to the shoreline and runoff from rainfall. While erosion has been identified as occurring within the city, few events were reported that resulted in damage. Based on past events and applying the criteria identified in Table 3-3b and the intensive development review in proximity to erosion hazard areas, the magnitude and severity of erosion impacts in the city are considered negligible, with the potential for critical facilities to be shutdown for 24 hours or less and less than 10 percent of property or critical infrastructure being severely damaged.

Impact

Impacts from riverine erosion include loss of land and loss of development on that land. Erosion can cause increased sedimentation of river deltas and hinder channel navigation affecting marine transport. Other impacts include reduction in water quality due to high sediment loads, loss of native aquatic habitats, damage to public utilities and economic impacts associated with costs trying to prevent or control erosion sites.

Probability of Future Events

Specific annualized loss data is not available for the identified areas however, based on previous occurrences and applying the criteria identified in Table 3-3a, it is possible that erosion will occur in the next five years (event has up to one in five years chance of occurring) as the history of events is greater than 10 percent but less than or equal to 20 percent likely per year. With the prediction of climate change, specifically higher amounts of rainfall in the fall and winter months, erosion potential is being scrutinized.

Current Erosion Plan

The 2008 *Erosion and Sediment Control Manual* is a key reference for actions to be taken to mitigate erosion in development and maintenance situations. This plan extends the vulnerability to not only riverine areas, but any location where land is being moved and therefore impacts the natural areas.

Title 10 and this Erosion Control Manual apply to all ground-disturbing activities, whether or not a permit is required, unless such activities are otherwise exempted by Portland City Code. Site planning and good site control are best practices that can be used to prevent discharges from a development site. The manual emphasizes careful planning and erosion prevention. Undisturbed groundcover must be retained whenever possible. This emphasis is particularly important in the Pacific Northwest immediately before and during the rainy season, when it is difficult to establish vegetation and the intense rains have high erosion potential.

3.3.6 Wildland Urban Interface Fire

3.3.6.1 Nature

Among the types of fires that affect Portland are wildland/urban interface and urban fires. Due to the large amount of forested land in the city, both are significant hazards.

Wildfires can be caused by human activities such as machinery operation, arson or campfires, or by natural events like lightning. Wildfires often occur in park land and open spaces or other areas of flammable vegetation. The 2009 Wildfire Readiness Assessment: Gap Analysis Report states that "Wildfires are increasing across the western United States. This increase is attributed to a buildup of forest fuels as a result of past fire suppression policies. Climate change increases the susceptibility of vegetation to fire due to longer dry seasons. The risk of loss to homes and businesses built at the margins of city natural areas is significant and growing. The Willamette Bluffs fires in 2000 and 2001 demonstrated this mounting wildfire risk. These fires, although successfully contained, highlighted the need for improved preparation, equipment, training and coordination"(Appendix H Reference: Portland 2009c).

The following three factors contribute appreciably to wildfire behavior.

- **Fuel:** The type and density of vegetation, as well as structures in the path of a fire. The four major fuel characteristics are fuel moisture, fuel size, horizontal continuity and vertical arrangement. Conifer trees are more susceptible to fire or will burn with greater intensity than deciduous trees. Dry dense vegetation increases the amount of combustible material available to fuel the fire (referred to as the "fuel load").
- **Topography:** Topography refers to earth's surface such as slope, aspect and shape. The steeper the slope the faster fires burn in an uphill direction. Chutes and steep sloped canyon shaped topography can cause fire to spread rapidly. South-facing slopes are also subject to more solar radiation, making them drier and thereby intensifying wildfire behavior.
- **Weather:** The weather includes temperature, wind, precipitation and humidity. Extreme weather, such as high temperatures coupled with low humidity, can lead to devastating wildfires. Conversely, cool temperatures and higher humidity often signal reduced wildfire occurrence and easier containment of existing fires.

In Portland, wildfires burn fuels in large natural area parks and open spaces at the wildland urban interface and in the interior of the city. Wildfires can be categorized as occurring in the following locations:

- **Wildland/Urban Interface:** Fires involving the wildland/urban interface occur in areas where urbanization and the presence of natural vegetation fuels allow a fire to spread rapidly from natural fuels to structures and vice versa. Especially in the early stage of such fires, structural fire suppression resources can be quickly overwhelmed, increasing the potential number of structures destroyed. Such fires are known for the large number of structures simultaneously exposed to fire. Nationally, wildland/urban interface fires commonly produce widespread losses.

- **Urban:** While these fires rarely spread out of control, thanks to proximity to fire resources and less fuel between buildings, urban conflagration is a hazard in densely populated areas. Many of the same factors that influence hazard in wildland/urban interface areas come into play in urban centers. Drought, high temperatures and fuel load are joined by factors such as flammable building materials, aging electrical wiring and closely packed structures to increase fire hazard.

Although thought of as a summer occurrence, wildfires can and do, occur during any month of the year. The vast majority of wildfires, west of the Cascade Mountains, occur between July and October. Dry spells especially when combined with the high winds or dead or dry fuels, result in fires that burn with alarming intensity and rate of spread.

Willamette Bluffs fire as seen from Forest Park, 2001

Portland natural areas and open spaces are fire-prone and fire-adapted ecosystems. The local forests, woodlands and grasslands evolved with fire over thousands of years. The moist western Oregon, natural plant communities burn less frequently, but when they do, the fires tend to be large and intense. Wildfires are part of the natural ecology and natural life cycles of wildlands. Fires create open spaces with different habitats for both plants and animals than existed previously. Fires also reduce fuel loads in areas, which in turn decreases the potential for large catastrophic fires (Appendix H Reference: ONHW 2004). In addition to threatening humans, animals and infrastructure, wildfires in forested areas have a severe impact on natural resources. Wildfires strip the land of vegetation and destroy forest resources. Soil exposed to intense heat may lose its capability to absorb moisture and support life. Exposed soils erode quickly and enhance siltation of rivers and streams, thus increasing flood potential, harming aquatic life and degrading water quality. Lands stripped of vegetation are also subject to increased debris flow hazards, as discussed earlier in the landslides hazard profile. (Appendix H Reference: Portland 2004a).

3.3.6.2 History

All of Portland's natural ecosystems have been highly modified by humans. Many wildfires have resulted from natural lightning strikes and intentional human activities. Historically, indigenous people purposely ignited large portions of the basin valley annually for agriculture, hunting, communication, warfare, visibility, safety and sanitation. Such systemic burning continued to shape the landscape to protect timber and property in the region (Appendix H Reference: ONHW 2004). When Anglo settlers arrived, they plowed native prairies and logged or cleared evergreen forests. Strategic seasonal burning ceased. As a result, woodlands grew denser and deciduous trees grew in among the evergreens. The mixed evergreen-deciduous forests we see today are much less fire prone than are pure evergreen forests. In part as a result of historic

fires and logging, 70% of Forest Park is fairly fire resistant as is much of the forest that rings Powell Butte. But over several decades these forests will grow back to evergreens.
Within the last 120 years, Portland's largest wildland/urban interface fires occurred in 1889, 1940 and again in 1951 charring 5,000 acres in and around Forest Park. Between 1998 and 2004, 1,302 incidents classified as natural vegetation fires were logged in Portland Fire & Rescue's records management system. Of these reported incidents, 595 were classified as grass fires, 657 were classified as grass and brush fires and 50 were classified as forest, or woods, fires. Powell Butte Nature Park has also experienced several fires since 1998, but most have been small. Two 3-alarm fires, however, have affected nearly 70 total acres of parkland and required more than 70 firefighters—nearly half of the City's on-duty strength—and more than two dozen pieces of firefighting apparatus (Appendix H Reference: Portland 2009c).


Willamette Bluff Wildfire, 2001

Portland's considerable urban forest, natural parks and open space areas, increase its susceptibility to wildfires within the city limit. The most recent sizeable wildfire was the Willamette Bluff (or Willamette Escarpment) fire that occurred in August of 2000. The fire started when a two-mile section of grass and brush ignited along the railroad tracks at the base of a bluff; the fire grew quickly in the grasses and heavier fuels along the escarpment – both indigenous brush species and invasive Himalayan blackberry – were quickly engulfed as the fire swept up the bluff. Fire companies set up along Willamette Boulevard eventually stopped the advancing fire, but the 5-alarm incident ultimately mobilized all off-duty members of Portland Fire & Rescue and mutual aid from five surrounding departments. Fortunately, the fire caused little structural damage yet still imposed significant costs (Appendix H Reference: Portland 2009c).

3.3.6.3 Location, Extent, Impact and Probability of Future Events

Location

Nearly every community in Oregon is at risk for wildland/urban interface fires, according to a United States Forest Service report identifying wildland/urban interface communities within the vicinity of Federal lands in Oregon (Federal Register 2001).

Portland covers 87,040 acres. Of these, 14,500 acres are categorized as natural areas and stream corridors and 4,000 acres are classified as developed parks and open spaces (Appendix H Reference: Portland 2004). The city's park natural areas designated as wildfire hazard areas include Powell Butte, the Willamette Bluffs or Escarpment, (Oaks Bottom and Mock's Crest) Marquam Nature Park, Terwilliger Wildlands, Kelly Butte, Rocky Butte and Mt. Tabor. The two largest areas are Forest Park and Powell Butte (Appendix H Reference: Portland 2009c). These natural areas have been identified as high risk by Oregon Department of Forestry and Portland Fire and Rescue because high-density commercial and residential development immediately surround the natural area parks and open spaces.

The Willamette Bluffs fires of 2000 and 2001 refocused the city's attention to reducing fuel loads through intergovernmental coordination. The Portland Wildfire Readiness Assessment and Gap Analysis Plan (2009) funded through Pre-Disaster Mitigation Grant funds, suggested that work is needed to "reduce wildfire risks to homes and their neighborhoods closest to the city's heavily forested areas. The Plan recommended improving zoning codes that require or encourage fire-resistant building materials, reducing hazardous fuels within a few hundred feet of buildings and maintaining adequate emergency vehicle access (Portland 2009c)."

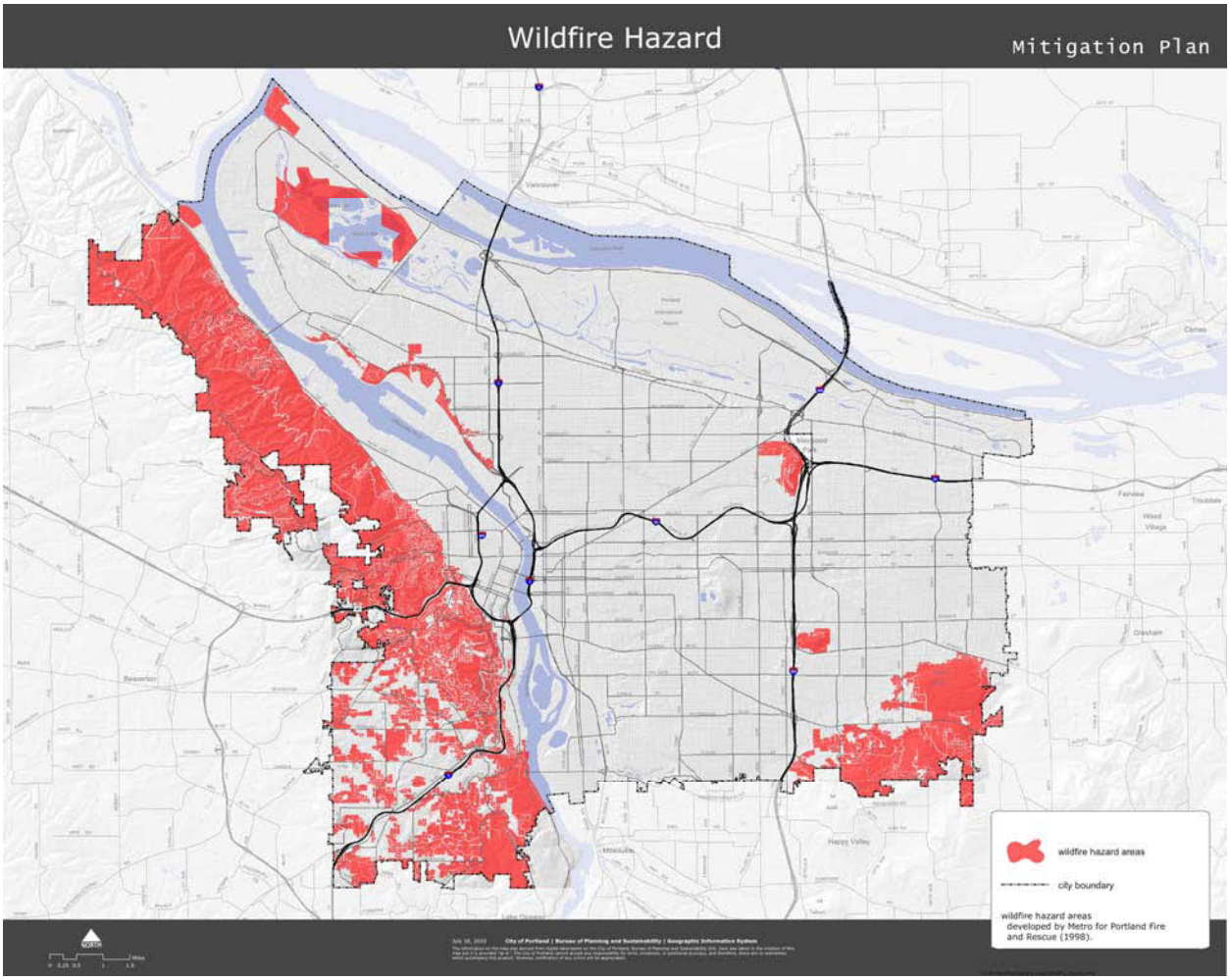
Forest Park comprises the city's largest urban natural area which encompasses over 5,000 acres extending approximately eight miles along the northeast slope of the Tualatin Mountains. This area includes a diverse ecosystem with a myriad of bird, plant and animal species. Mixed deciduous (70 percent) and conifer (30 percent) growth reduce catastrophic fire potential in this location but could quickly change
during intense dry seasons. Grasslands and large patches
of flammable invasive species are at the edges of the park and in power line and utility corridors. These areas are often susceptible to fire.

Powell Butte Nature Park, the adjacent Clatsop Butte Park natural area and the treed Johnson Creek floodplain encompass over 1,000 acres of parks, dense tree canopy and urban interface development in Southeast Portland. Powell Butte is also the site of the Water Bureau's above and underground reservoir system. Powell Butte's vast meadowlands and interspersed forests are the focus of the wildfire threat in this area. The Park's east side is at risk due to the close proximity of development to the meadow and the east winds of late summer and early autumn which, if ignited, could spread fires west to the forested area of the park. With the exception of some housing in close proximity to the meadow near the park entrance most development is downhill from the park, on the west slopes, sheltered from the dry winds.

In SW and NW Portland the steep slopes of Forest Park, Marquam Nature Park and Terwilliger Wildlands, face into the strong, dry, east winds that funnel out of the Columbia Gorge most autumns. In SE Portland, Powell Butte, Mt. Tabor Park, Kelley Butte and Rocky Butte have a similar landscape position facing the east winds. Many of the developments that hug the west side of Forest Park or are at the top of the Willamette Escarpment were built without consideration of the path of historic fires.

In the fall of 2009 the Portland City Council approved the formation of a City/County Wildfire Technical Committee. This group will focus on improving wildfire preparation, equipment, training and coordination city and county wide. It will be the first step toward developing a Community Wildfire Protection Plan that will enable future funding opportunities for mitigation efforts.

Figure 3-3-6a City of Portland Wild Fire Hazard Area



Extent

Since 2006, Portland Parks and Recreation and the Bureau of Environmental Services have begun work to reduce hazardous wildfire fuels by removing non-native and invasive vegetation in the most highly threatened natural area parks and adjacent open space areas. Hazardous fuel reduction activities in the most highly threatened areas are needed and performing extensive fuel reduction activities in the most highly threatened areas will be the focus of wildland urban interface fire mitigation programs in the next five years. (Appendix H Reference: Portland 2009c).

Due to successful fire control, the minor wildfires that have occurred in the city have damaged relatively few residential areas, scattered buildings and natural resources in the affected forests. However, when a major wildfire occurs, it will have the potential to severely impact residential structures, roads, power lines and other critical infrastructure.

According to the hazard assessment the extent of wildfire events in the city are limited where injuries and/or illnesses do not result in permanent disability, complete shutdown of critical facilities may last for more than one week and more than 10 percent of property is severely damaged.

Impact

Impacts associated with a wildfire event include potential life and property losses. Wildfire can also impact livestock and pets, destroy forest resources and contaminate water supplies. The wildland/urban interface areas are more vulnerable due to vegetation surrounding structures and buildings predominately of wood construction. Recent research by the US Forest Service and others suggests that the best way to protect businesses and neighborhoods from wildfire is to focus on the buildings and a 30-100 foot perimeter (defensible space).

Impacts to future populations, residences, critical facilities and infrastructure are anticipated. Increased community education, the use of fire resistant building materials, enhanced training of response personnel are some actions that could lessen future impacts.

Probability of Future Events

In Oregon, wildfire season normally begins in late June, peaks in August and ends in October. However, a combination of above normal-temperatures and drought can increase the length of the traditional fire season. Wildfire hazards would be highest during prolonged periods of drought, especially after periods of below normal rainfall, which would result in a combination of high fuel loads and unusually dry conditions.

The probability of a minor wildfire occurring is very high. Although the city has never experienced major fires that have affected other areas in Oregon, there is a possibility that a future major wildland/urban interface or urban fire could occur within the city limits.
An important issue related to the probability of wildland/urban interface fire is the increased development in the interface areas, the accumulation of hazardous wildfire fuels and the uncertainty of weather patterns that may accompany climate change. These three elements combined are reason for concern and heightened mitigation management of Portland's wildland interface areas, natural area parks and open spaces.

Urban fires are the most preventable type of fire and future events depend largely on prevention measures. Although no historical urban conflagration in the city has occurred, educating residents, enforcing building and maintenance codes and improving firefighting equipment, staff and response systems are actions that can ensure that localized urban fires do not become large-scale conflagrations.

Based on previous occurrences and the criteria identified in Table 3-3a, it is likely a wildfire event will occur within the city limits (event is probable within the next three years, event has up to 1 in 3 years chance of occurring, history of events is greater than 20 percent but less than or equal to 33 percent likely per year). Climate change and flammable invasive species are already affecting the Pacific Northwest forests. Fire frequency may increase in the future as a result.

3.3.7 Invasive Plant Species

3.3.7.1 Nature

RestoreForestPark.org

Invasive plants are those species that spread at such a rate that they cause harm to human health and the environment. In general, most invasive plants are non-native species, however, not all non-native plants are invasive (Appendix H Reference: Portland 2009d).

Invasive plants have been introduced into an environment in which they did not originate. They lack natural enemies, grow and reproduce quickly and are able to thrive in a wide variety of conditions. These characteristics allow plants to invade new habitats and out-compete natives, resulting in dense thickets of a single plant species. Dense thickets of invasive plants limit native plant diversity which in turn reduces food and shelter for wildlife. Invasive plants are the second leading cause of species extinction. Many invasive plants have shallow root systems that provide limited erosion control. Invasive plants also shade out native seedlings resulting in fewer trees. Less shade creates higher water temperatures, reducing oxygen for fish and other aquatic animals. Reduced tree cover also reduces storm water interception and absorption of $C0^2$ which interferes with the stabilization of the earth's temperature.

The City of Portland Bureau of Planning and Sustainability has developed lists of native, nuisance and prohibited plants. All of the species on the City's nuisance list and all of the species on its prohibited list are considered invasive plants. A native plant is a species that was likely found historically (prior to European settlement) in the Portland area. Nuisance plants are considered harmful to humans and plants and have a tendency to dominate plant communities. The five species on the City's prohibited plant list pose a serious threat to the health and vitality of native plant and animal communities. Species on the nuisance and prohibited plant lists cannot be used in required landscape areas within city limits (Appendix H Reference: Portland 2009d). The plants on the nuisance and prohibited plants lists cannot be planted in the Environmental Overlay Zone, the Pleasant Valley Natural Resource Overlay Zone and the Greenway Overlay Zone.

Overlay zones within City Code Title 33, Chapters 33.430 – Environmental, 33.440 – Greenway and 33.465 – Pleasant Valley Natural Resource, provide implementation for land use patterns in these areas. Environmental zones are all over Portland and the Greenway Zones are along the Willamette River. The zoning intent is to protect existing natural areas and their amenities by stating design standards and criteria that will protect the site resources. Zoning information can be accessed on the Portland map site on the Portlandonline.com website main page.

When invasive plants like English ivy or clematis dominate the groundcover, there is very little root structure to bind the soils. Therefore, large areas dominated by invasive plants are more likely to erode during flood events than areas with a diverse understory of trees and shrubs, which provide more root structure diversity.

Native plant roots extend deep into the soil and many species have wide, branching fibrous root structures that bind the soils and reduce erosion. Erosion releases sediment to streams, increases stream turbidity and impairs water quality.

Invasive plants provide less streamside cover and shade increasing stream temperatures. Invasive plants, such as Japanese knotweed or Himalayan blackberry, form monocultures (areas entirely dominated by one species) next to streams, which prevent tree establishment (Portland 2009d).

Figure 3-3-7a Sample of Portland's Invasive Plants (Portland 2009c)

English Ivy

Clematis

Himalayan Blackberry

Monocultures of invasive plants create fuel for wildfires. English ivy or clematis vines climb trees and can become a conduit for fire to reach the tree canopy, where it is more difficult to control and more likely to threaten nearby structures.

Invasive plants can reduce the amount of tree cover by preventing trees from becoming established, causing them to fall down prematurely, or reducing their growth rate. Dense cover by Himalayan blackberry can prevent sunlight from reaching seedlings or saplings. Dense English ivy or clematis in the tree canopy can weigh down trees, making them more susceptible to blow downs and decreasing their growth rates by shading the leaves.

3.3.7.2 History

Most invasive plants arrived in Oregon through intentional introductions, however, in most cases, the uncontrolled spread was not anticipated. The number of new introductions has increased consistently with global trade and travel. Most invasive plant introduction pathways are human induced; the plants and their seeds travel on cars, trains, heavy equipment, boats, shoes and pets. The plants tend to become established along transportation corridors such as roads, utility easements, trails, parks and ports of entry. Humans also introduce new invasive plants through the nursery trade and gardening. Invasive plants are also transported through ecological pathways such as wind, wildlife, streams and other waterbodies. Land management practices such as mowing or constant soil disturbance also facilitate the establishment of and persistence of invasive plants.

The following descriptions provide a brief overview of how invasive species have affected watershed health historically in the city:

- **Water quality:** reduction in soil stability and of canopy diversity from invasive species results in increased stream temperatures and increased erosion.
- **Biodiversity:** rapid spread of invasive plant species creates monocultures by displacing native plants or by preventing their growth and establishment (which has affected water and air quality and stabilization of stream banks).
- **Habitat:** simplification of a plant community structure by an invasive plant monoculture reduces fish and wildlife habitat.
- **Tree Cover:** invasive cover in the shrub and groundcover layer prevents a natural forest regeneration processes.
- **Soil Health:** soils altered through allelopathy (the process of releasing chemicals that alter the soil chemistry and soil fungal processes thereby inhibiting the growth of neighboring plants, by another plant).
- **Wildfire:** some invasive plant species act as "fuel ladders" which facilitate the ability of a fire to travel into the tree canopy of conifers. Presence of invasive species makes the fire hotter, more difficult to control and more likely to continue to spread.
- **Stormwater:** forming monocultures, invasive species often preclude the establishment of native vegetation and tree canopy, altering vegetation cover types which can result in reduced stormwater interception by trees (Portland 2008a).

3.3.7.3 Location, Extent, Impact and Probability of Future Events

Location

Invasive species can grow anywhere and are prolific throughout the city. Portland Parks and Recreation (PP&R) City Nature Program manages over 8,000 acres of natural areas and hybrid park land within the city for recreational uses and habitat protection (Appendix H Reference: Portland 2009c).

PP&R has conducted vegetation surveys on 7,800 acres of natural area parkland. Their field methods were designed to identify vegetation community characteristics such as dominant invasive plant species, management concerns and overall ecological health to inform park management and citywide natural resource planning (Appendix H Reference: Portland 2008a).

Extent

Based on the pervasive nature of invasive plant species and the criteria identified in Table 3-3a, the extent of invasive plant impacts in the city are considered critical. Invasive plant species are a hazard that threatens life and infrastructure because of the impact they have on the watersheds. Their growth causes unstable soil which becomes more vulnerable to landslides, greater fuel for wildfire and impairs the tree canopy which stifles CO^2 generation. This hazard category is a current environmental condition which if not mitigated could exacerbate an event;

it is difficult therefore to apply the extent equation to it. But because of its extreme coverage and impact it is included as a part of the mitigation strategy. There are some plants that do cause injury and death to people and animals due to their toxicity and/or skin reaction.

Of the 7,800 acres of PP&R land surveyed, invasive plants cover approximately 13 to 40 percent of the acreage (data was collected in ranges). There are approximately 32,162 acres of forest, woodland, shrubland and herbaceous vegetation patches within the city. Thus, if the PP&R data are extrapolated to estimate the amount of invasive plants that are likely to be present within vegetated areas in the city, then there would be approximately 4,181 – 12,864 acres of invasive plant coverage within city limits.

Extensive infestations of invasive vines can also be implicated in multiple natural hazards. Trees overburdened with ivy or clematis vines are commonly found alongside several important traffic corridors in the city (Hwy. 26, Hwy. 30, Germantown Road). These overburdened trees are unstable and are often uprooted during rain or snow events and fall across power lines or roadways. When found on step unstable slopes these infested trees can be blown down and become involved in localized landslides.

Purple Loosestrife at Oaks Bottom Wildlife Refuge

Table 3-3-7a Invasive Plant Species within Portland

Species	Description of Removal Techniques
English ivy	Removing berries prevents birds from spreading seeds. Pulling ivy and removing roots is effective for small areas. Repeated pulling may be necessary. Cut vines all the way around a tree trunk to 4.5 feet from the ground to kill ivy in the upper branches. Clear ivy from a six-foot radius around the base of a tree.
Himalayan blackberry	Hand-pull, cut or mechanically remove the canes, then dig out the roots. Even very small root fragments can re-sprout as new plants.
Knotweed	Knotweed reproduces from rhizomes, which must be dug up for effective control. Mowing and cutting are not sufficient. This plant also reproduces from cut stem fragments so do not leave cut stems on the ground.
Morning glory (bindweed)	Hand pull small plants or new infestations. For larger infestations, dig up the entire plant, including rhizomes below ground. This plant reproduces from stem and rhizome fragments. Follow-up treatment will be necessary.
Purple loosestrife	This plant reproduces from root fragments so the entire root system must be removed. Pull plants before seed set because each plant can produce 100,000 seeds.
Scotch broom	For plants less than three feet tall, pull up the roots. It is possible to cut the stems of larger plants near the ground, but about half of them will re-grow from cut stumps, so follow-up treatments may be necessary. Cut or pull plants before seed set from July to September because mature plants can produce 300 seeds per bush and seeds persist in the soil for up to 80 years.
Wild clematis	Cut vines from tree canopies and dig up roots at the base of the vine. Tracing the vine back to the basal clump is easier in winter. For older plants too large to dig, a cut stump herbicide treatment may control re-sprouting from the base.
English holly and English laurel	Cut with a chainsaw or loppers. Periodically cut re-sprouting plants. Applying herbicides on waxy leaves is not effective, but a cut stump herbicide treatment can control re-sprouting from the base.
Butterfly bush	Pull small plants and be sure to remove the roots. You can cut back large plants, but many will re-sprout from cut stumps. Use a woody plant puller in moist soils to remove the entire root system. For older and larger specimens, a cut stump herbicide treatment may control re-sprouting from the base.
Indigo bush	Clip flower heads before seed set to limit seed production and distribution. Cut stems will re-sprout so removal must include the roots or re-sprouting plants can be treated with herbicide*. Since plants grow near water, hiring a professional to implement herbicide applications is recommended.

Impact

The City has long-recognized invasive plants as a problem. The most recent *Portland Plant List* lists 163 plant species divided between the City's adopted Nuisance Plant List and the Prohibited Plant List. The nuisance and prohibited plants are considered invasive plants and are a problem in Portland because they threaten the vitality of the native ecosystem and because they do not provide the protection to the environment that is needed to reduce the impact of other hazards such as erosion, landslide and wildfire. Controlling and/or eradicating invasive plant species can mitigate the impact of these hazards. (Appendix H Reference: Portland 2008a).

In a national study of 12 different invasive plant species, the median cost of early detection, control and eradication was $1 for every $17 dollars of future potential damage that would have been caused by that species (U.S. Congress 1993). A similar study, conducted in Oregon by the Oregon Department of Agriculture (ODA), found that every $1 spent today on early detection and control, saves up to $34 in future cost impacts (Appendix H Reference: Oregon 2009a, Portland 2009d).

Probability of Future Events

Since the category of invasive plant species is not an event but a current environmental condition, the probability equation does not apply. Therefore, based on past invasive plant propagation, it is expected that invasive plant impacts will remain relatively consistent with past occurrence rates. But in fact invasive plant propagation is increasing due to the global transportation system. Transport of plants, objects that contain pests, seeds and rhizomes (or plant root such as ginger or iris) can be transported to places in very little time. The native systems don't have defenses to these plants and pests and therefore, impacts are substantial.

Current Mitigation Projects

The Invasive Plant Policy Review and Regulatory Improvement Project is revising and consolidating the nuisance and prohibited lists into one list called the Nuisance Plants List. All the plants on the list are considered invasive; none of the plants on the list are native. Portland does not distinguish between the nuisance or prohibited listings any longer.

3.3.8 Volcanic Activity

3.3.8.1 Nature

Mt. St. Helens Eruption, 1980

A volcano is a vent or opening in the earth's crust from which molten lava (magma), pyroclastic materials and volcanic gases are expelled onto the surface. Volcanoes can unleash destructive power greater than nuclear bombs and pose a serious hazard if located near populated areas. Ash fall and tephra, the expelled cloud of gas and granular volcanic rock, could impact city operations and air quality.

There are four general types of volcanoes found within a short distance of the city:

- **Lava domes** are formed when lava erupts and accumulates near the vent.
- **Cinder cones** are formed by accumulation of cinders, ash and other fragmented materials originating from an eruption.
- **Shield volcanoes** are broad, gently sloping volcanic cones of flat domical shape, usually several tens or hundreds of square miles in extent, built chiefly of overlapping and interfingering basaltic lava flows.
- **Composite or stratovolcanoes** are typically steep-sided, symmetrical cones of large dimensions built of alternating layers of lava flows, volcanic ash, cinders and blocks. Most composite volcanoes have a crater at the summit containing a central vent or clustered group of vents.

Along with the different kinds of volcanoes there are different types of eruptions. The type of eruption is a major determinant of what physical results an event will create and what hazards it poses. Six main types of hazards associated with volcanoes exist:

- **Volcanic gases** are made up of water vapor (steam), carbon dioxide, ammonia, as well as sulfur, chlorine, fluorine, boron and several other compounds. Wind is the primary source of dispersion for volcanic gases. Life, health and property can be endangered from volcanic gases within about six miles of a volcano. Acids, ammonia and other compounds present in volcanic gases can damage eyes and respiratory systems and heavier-than-air gases, such as carbon dioxide, can accumulate in closed depressions and suffocate humans or animals.
- **Lahars** are formed when loose masses of unconsolidated, wet debris become mobilized and are usually created by shield volcanoes and stratovolcanoes. Eruptions may trigger one or more lahars by quickly melting snow and ice on a volcano or ejecting water from a crater lake. More often, lahars are formed by intense rainfall during or after an eruption. Rainwater can easily erode loose volcanic rock and soil on

hillsides and in river valleys. As a lahar moves farther away from a volcano, it will eventually begin to lose its heavy load of sediment and decrease in size.

- **Landslides** are common on stratovolcanoes because their massive cones typically rise thousands of feet above the surrounding terrain and are often weakened by the very process that created the mountain – the rise and eruption of molten lava (magma). If the moving rock debris is large enough and contains a large content of water and soil material, the landslide may transform into a lahar and flow more than 50 miles from the volcano.
- **Lava flows** are streams of molten rock that erupt from a vent and move down slope. Lava flows destroy everything in their path. However, deaths caused directly by lava flows are uncommon because most move slowly and flows usually do not travel far from the source vent. Lava flows can bury homes and agricultural land under hardened rock, obscuring landmarks and property lines.
- **Pyroclastic flows** are dense mixtures of hot, dry rock fragments and gases that can move as fast as fifty miles per hour. Most pyroclastic flows include a ground flow composed of coarse fragments and an ash cloud that can travel by wind. Escape from a pyroclastic flow is unlikely because of the speed at which they move.
- **Tephra** (also known as ash) is a term describing any size of volcanic rock or lava that is expelled from a volcano during an eruption. Large fragments generally fall back close to the erupting vent, while particles of ash can be carried hundreds to thousands of miles away from the source by wind. Ash clouds are common adaptations of tephra.

3.3.8.2 History

Mt. St. Helens has been the most active volcano in the Cascade Range during the past 10,000 years. Early 19th century settlers in the region witnessed eruptions occurring along the north flank area of the mountain. In Oregon, awareness of the potential for volcanic eruptions has greatly increased since the May 18, 1980 eruption which killed 57 people. The upper portion of the summit collapsed in a massive landslide triggered by volcanic tremors. That portion of the mountain is now a horseshoe-shaped crater partially filled by a lava dome.

As a result of the 1980 Mt. St. Helens eruption and the far-reaching extent of the lateral blast, damage and reconstruction exceeded $1 billion. The coverage area was 230 square miles and reached 17 miles northwest of the crater. Impacts from pyroclastic flows covered six square miles and reached five miles north of the crater. Landslides covered 23 square miles. Lahars (mudflows) affected the North and South Forks of the Toutle River, the Green River and ultimately the Columbia River, as far as 70 miles from the volcano.

Mt. St Helens' most recent eruption began in October of 2004, with initial steam and ash eruptions giving away to slow-moving lava flows which ceased in January of 2008.

One of Mt. Hood's earliest recorded eruption occurred in approximately 1805. Two other minor eruption periods occurred during the last 500 years with some lava flow near the summit. The eruptions created pyroclastic flows and lahars with little ash fall. Other volcanoes throughout the Pacific Northwest have undergone similar formation and eruption cycles (MHFC 2005).

3.3.8.3 Location, Extent, Impact and Probability of Future Events

Location

The extensive north-south chain of volcanoes in the Cascade Range was formed by earthquakes originating from the Cascadia Subduction Zone. As the Juan de Fuca Plate sinks beneath the North American Plate, it heats up and begins to melt, providing a vast reservoir of the heat and molten rock that create the magma chambers that become volcanoes.

The USGS provides descriptions of the four closest volcanoes to the city, Mt. Adams, Mt. Hood, Mt. St. Helens and Mt. Jefferson, all located to the east of the city. (Appendix H Reference: USGS 2009a).

- **Mt. Adams** stands approximately 31 miles due east of Mt. St. Helens. The towering stratovolcano (12,276 feet) is marked by a dozen glaciers, most of which are fed radially from its summit icecap. In the Cascades, Mt. Adams is second in eruptive volume only to Mt. Shasta and it far surpasses its loftier neighbor Mt. Rainier. Mt. Adams' main cone exceeds 124 cubic miles.
- **Mt. Hood** is located approximately 47 miles east-southeast of Portland and is the most accessible Oregon volcano. Access to the volcano is provided by US Highway 26 from the south and west and Oregon Highway 35 from the east. Other paved roads provide further access to this most often-climbed peak in the Pacific Northwest. In the winter, the mountain hosts winter sports. At 11,239 feet, Mt. Hood is the highest peak in the state and is part of the Mt. Hood National Forest (Appendix H Reference: USGS 2009a).
- **Mt. St. Helens,** a stratovolcano, is located approximately 50 miles northeast of Portland in Skamania County, Washington and has an elevation of 8,365 feet. Access is provided from the west in Cowlitz County by State Route 504. (Appendix H Reference: USGS 2009a).
- **Mt. Jefferson** is located in the Mt. Jefferson Wilderness area and the Warm Springs Indian Reservation, approximately 70 miles from Portland. It is the second highest peak in Oregon at 10,497 feet. Access is provided by Highway 22 east of Salem and US Forest Service roads and trails that lead into the wilderness area (Appendix H Reference: USGS 2009).

Figure 3-3-8a Portland's Volcano Locational Relationship

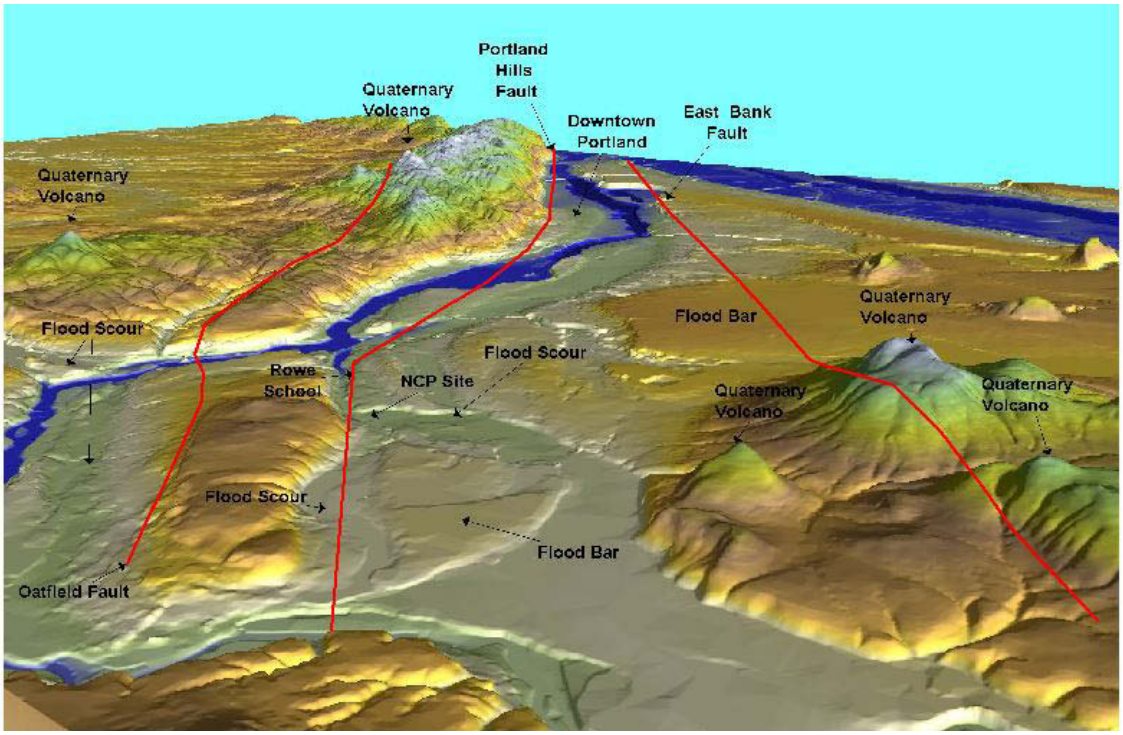


Photo courtesy of Ian Madin, DOGAMI

Extent

Mt. St. Helens is believed to be the volcano with the greatest potential to have a near-term impact on the region because of its ongoing activity since the cataclysmic event in May 1980. A large eruption of Mt. St. Helens can eject tephra to altitudes of 12 to 20 miles and to deposit tephra over an area of 40,000 square miles or more. Wind direction and velocity, along with the vigor and duration of the eruption, will control the location, size and shape of the area affected by tephra fall.

Mt. St. Helens most recently erupted in October of 2004, pushing ash more than 10,000 feet into the air and lava flows continued until January 2008, after which activity ceased. The volcano has been recently downgraded to inactive, although another eruption in the near future is highly likely.

Due to proximity, the major hazard for the city would be impacts from ash or tephra. (i.e., minor ash falls from eruptions from Mt. St. Helens, or lesser ash falls from more distant volcanoes). Prevailing wind is a factor in how much ash is disbursed within the city. Volcanic eruptions may impact water bodies. River valleys are susceptible to debris flows, landslides and lahars that, under extreme conditions, may require dredging to maintain channel depths for navigation.

The entire city's buildings, streets and roads would require minor cleanup with negligible impacts. Temporary utility interruptions are likely and minor cleanup may be required for

electrical and other utility services. Water treatment facilities may require additional attention to address high turbidity. Respiratory problems may result. Volcanic ash fall event extent category lies between limited and negligible, as an event may cause injuries and/or illnesses that do not result in permanent disability, complete shutdown of critical facilities for more than one week is not expected and less than 10 percent of property would be severely damaged.

Impact

The most predominate threat to the city would occur from volcanic ash clouds, drifting downwind potentially landing several miles from the volcano. Events can vary from minor to heavy, with minor events reducing visibility and increasing respiratory and breathing difficulty. Driving can become potentially treacherous from reduced visibility and particulate ingested engine damage. Other problems common from air-entrained ash particles could include clogged and damaged sewage systems, mechanical equipment failure caused by the abrasive nature of volcanic ash and economic losses caused by business slowdowns and the cost of ash removal.

Heavy ash fall could affect humans and aquatic life as the ash accumulation increases the natural turbidity of waterbodies, causing increased treatment requirements. Heavier ash fall collects on all surfaces such as rooftops, decks and parking lots and requires removal. Secondary impacts would be dust clouds generated by ash removal and surface damage from the scratchy nature of the tephra particulates.

Ash clouds are especially damaging to jet aircraft as ash clouds can drift great distances at high altitudes. The city's international airport and other area airports are especially vulnerable and temporary flight restrictions and diversions may be required during active ash fall events.

Probability of Future Events

Mark Monmonier, in his book *Cartographies of Danger: Mapping Hazards in America* (1997) states, " Based on distance, eruption frequency and estimated volume of ash, … probabilities are highest between Mt. St. Helens and Mt. Adams – relatively close to each other – where a probability [is] greater than 1 in 100 [= 1 percent chance of occurring] during a single year of a highly significant ash fall ... [whereas] the risk at Portland, … is much closer to 1 in 1,000 [= .01 percent chance of occurring]."

By careful analysis of past activity, geologists can make general forecasts of long-term activity associated with individual volcanoes, but these are on the order of trends and likelihood, rather than specific events or timeline. Short-range forecasts are often possible with greater accuracy. Several signs of increasing activity can indicate that an eruption will follow within weeks or months. Magma moving upward into a volcano often causes a significant increase in small, localized earthquakes and increased emissions of carbon dioxide and compounds of sulfur and chlorine that can be measured. Shifts in magma depth and location can cause changes in ground level elevation that can be detected through ground instrumentation or remote sensing.

Section 4 Vulnerability Analysis

4.1 OVERVIEW OF A VULNERABILITY ANALYSIS

DMA 2000 Requirements: Risk Assessment, Assessing Vulnerability, Overview

> **Requirement §201.6(c)(2)(ii):** [The risk assessment shall include 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.

DMA 2000 Requirements: Risk Assessment, Assessing Vulnerability, Addressing Repetitive Loss Properties

> **Requirement §201.6(c)(2)(ii):** [The risk assessment] **must** also address National Flood Insurance Program (NFIP) Insured structures that have been repetitively damaged floods. (Table 4-3-1a)

DMA 2000 Recommendations: Risk Assessment, Assessing Vulnerability, Identifying Structures

> **Requirement §201.6(c)(2)(ii)(A):** The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure and critical facilities located in the identified hazard area. (Tables 4-4-1a and Table 4-4-2a)

DMA 2000 Recommendations: Risk Assessment, Assessing Vulnerability, Estimating Potential Losses

> **Requirement §201.6(c)(2)(ii)(B):** The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate. (Tables 4-4-1a and Table 4-4-2a)

A vulnerability analysis is a methodology which documents the extent of exposure that may result from a hazard event of a given intensity in a given area. The analysis provides quantitative data that may be used to identify and prioritize potential mitigation measures by allowing communities to focus attention on areas with the greatest risk of damage. A vulnerability analysis is divided into five steps: asset inventory, methodology, data limitations, exposure analysis for current assets and areas of future development.

Emergency Management Performance Grant funding requires local hazard vulnerability analyses be current and updated within the past ten years. The State of Oregon requires the update every five. The City of Portland's Hazard Vulnerability Analysis was updated in 2006 and will be updated in 2011.

The requirements for a vulnerability analysis as stipulated in DMA 2000 and its implementing regulations are described here. Refer to Appendix A Page 7.

4.2 VULNERABILITY ANALYSIS: SPECIFIC STEPS

4.2.1 Asset Inventory

Asset inventory is the first step of a vulnerability analysis. Assets that may be affected by hazard events include population, environment, residential buildings and critical facilities and infrastructure. The assets and associated values throughout the City are identified and discussed in the following sections. The current Asset Management report inventoried City asset replacement which the strategic plan for 2010-2014 addresses.

Bureau of Environmental Services Laboratory, St. Johns

The City seeks to protect its population by supporting State of Oregon initiatives, ordinances, building codes, development regulations and NFIP criteria. Through implementation of State Land Use Goal 7, any development, environmental adjustment or essential infrastructure or facility will undergo government inspection and review to ensure potential hazard risk is mitigated. Updated hazard maps, further hazard research and policy updates will enable greater implementation of this goal. By 2015, the City Asset Management Plan will have identified high-risk assets and prioritized monitoring and data collection.

4.2.2 Methodology

The Citywide Asset Report outlines criteria for replacement and maintenance of city-owned infrastructure and buildings. The 2008 report specifically identified risk analysis from unforeseeable occurrences as a factor to be considered in the study. Risk consequences and likelihood of failure were outlined as process elements that each bureau should incorporate into their asset management plan. The 2008 report concluded that most bureaus have limited capacity to predict likely failure modes for assets and have not estimated the likelihood and consequence of asset failure. City facilities were estimated at $23.1 billion in replacement value (Appendix H Reference: Portland 2009i). City assets include parks, structures and infrastructure.

A conservative exposure-level analysis was conducted to assess the risks of identified hazards. This analysis is a simplified assessment of the potential effects of the hazards on properties at risk without consideration of probability or level of damage.

Using census block level information, a spatial proportion was used to determine the percentage of the population and residential and nonresidential structures located where hazards are likely to occur. Census blocks that are completely within the boundary of a hazard area were determined to be vulnerable and were considered uninhabitable. A spatial proportion was also used to determine the amount of linear assets, such as highways, within a hazard area. The exposure analysis for linear assets was measured in miles.

Spatial Proportion is the scientific standard for describing what percentage of an area is affected by defined levels of impact. It defines the strength of an area affected by a hazard. Hazards labeled as "descriptive" use simple narrative statements to describe that hazard's impact. Spatial refers to the distance or interval of space, without specifying units. Proportion is a mathematical term which deals with ratios or compares one relationship to another. Therefore, the spatial proportion of an earthquake is the industry standard term defining a comparative threat to adjacent areas.

Table 4-4-1a on page 104 gives the spatial extent across the hazard area to depict them as strong, very strong or severe impact areas. The "methodology" defines the parameters used to identify this spatial label by the representative "proportion" (percentage) of the area where a given gravitational force (g) occurs across the entire community (the spatial extent).

Property replacement value information is not available for all critical facilities at this time and will be collected as it becomes available. For each physical asset located within a hazard area, exposure was calculated by assuming the worst-case scenario (that is, the asset would be completely uninhabitable or destroyed and would have to be replaced).

A similar analysis was used to evaluate the proportion of the population at risk. However, the analysis simply represents the number of people at risk; no estimate of the number of potential injuries or deaths nor demographics of the affected population was prepared. This was done in the 2004 HAZUS-MH process and can be used as a reference when calculating potential injuries and/or deaths.

4.2.3 Data Limitations

The vulnerability estimates provided use the best data currently available and the methodologies applied result in a risk approximation. These estimates may be used to understand relative risk from hazards and potential losses. However, uncertainties are inherent in any loss estimation methodology, arising in part from incomplete scientific knowledge concerning hazards and their affects on the built environment as well as the use of analysis that is necessary for a comprehensive report.

It is also important to note that the quantitative vulnerability assessment results are limited to the exposure of people, buildings and critical facilities and infrastructure to the identified hazards. It was beyond the scope of this NHMP to develop a more detailed or comprehensive risk assessment (including annualized losses, people injured or killed, shelter requirements, loss of facility/system function and economic losses). Such impacts may be addressed with future updates of the NHMP and a possible update of a HAZUS-MH data analysis.

Unreinforced masonry building vulnerable to seismicity

4.2.4 Exposure Analysis

Exposure analysis will be a part of the 2010-2015 NHMP review process as high hazard areas are further analyzed for impact to infrastructure, possible land uses and population vulnerabilities. Figure 4-3-2a, Electrical Transmission System and Pipelines and Figure 4-3-2b, City owned properties, along with the URM maps included in Appendix J map structures vulnerable to the various hazards of Portland are references.

4.2.5 Population and Building Stock

There are 582,130 residents in the city of Portland with the median age of 37. A total of 249,928 single-family residential buildings and 212,476 buildings (90% were reviewed for age in the Portland Plan's Historical Resources Background Report). Portland zoning code establishes percentages of use in specific sub-geographic areas. These areas are neighborhood coalition areas. The largest area zoned for commercial is the Lloyd District, with all other sub-geographic areas having less than 10% each. Industrial zoning is predominately in the North Portland area with 44% and 19% of the NW area zoned industrial. SW Neighborhood Inc. (SWNI) sub-geographical area is zoned 82% residential with 78% in NE Coalition of Neighborhoods (NECN) and 70% in SE Uplift Coalition (SEUL) and 69% in the area of the East Portland Neighborhood Organization (EPNO). Available land for commercial use is under 5% in each of the sub-geographic areas. These percentages show the amount of housing or commercial use allowed, not the amount that is currently used. This information used in collaboration with demographics, building age, hazards of the area and resources locally available all inform the vulnerability of areas of Portland.

4.3 REPETITIVE LOSS PROPERTIES

Mitigation of repetitive loss properties is a major concern because of the impact on limited response resources, reoccurring costs of repair and the aggregated cost of insurance of properties within the insurance covered area. By mitigating the repetitive loss properties, insurance coverage costs for other homeowners and businesses could lower and emergency response could concentrate on other needs in flooded areas potentially serving people with the greatest need.

There were five repetitive loss properties identified after the 2009 floods dispersed throughout the City, though four properties are located in the Johnson Creek Watershed. These properties tend to cluster along Johnson Creek between SE 103rd to 159th, and on the east and west sides of the Sellwood Bridge.

The Columbia River and Lower Columbia Slough also pose a potential threat to property within the floodplain. Properties protected by the Multnomah County Drainage District (MCDD) system of dikes are valued at more than $20 billion and include the Portland International Raceway, the Portland Expo Center, the Portland International Airport, the Columbia Industrial Corridor, several residential neighborhoods and the City's drinking water well system. The estimate included in the June 2009 Portland Airport Futures – Economic Development Inventory report reviewed 8,600 acres from I-5 to 185th from the Columbia River to Columbia Boulevard identifying 8,600 jobs and over 10,000 jobs in transport and warehousing. This estimate of property value protected by MCDD was created by the Columbia Corridor Association in 2009. The cost of replacing the infrastructure protected by Multnomah County Drainage District would be devastating.

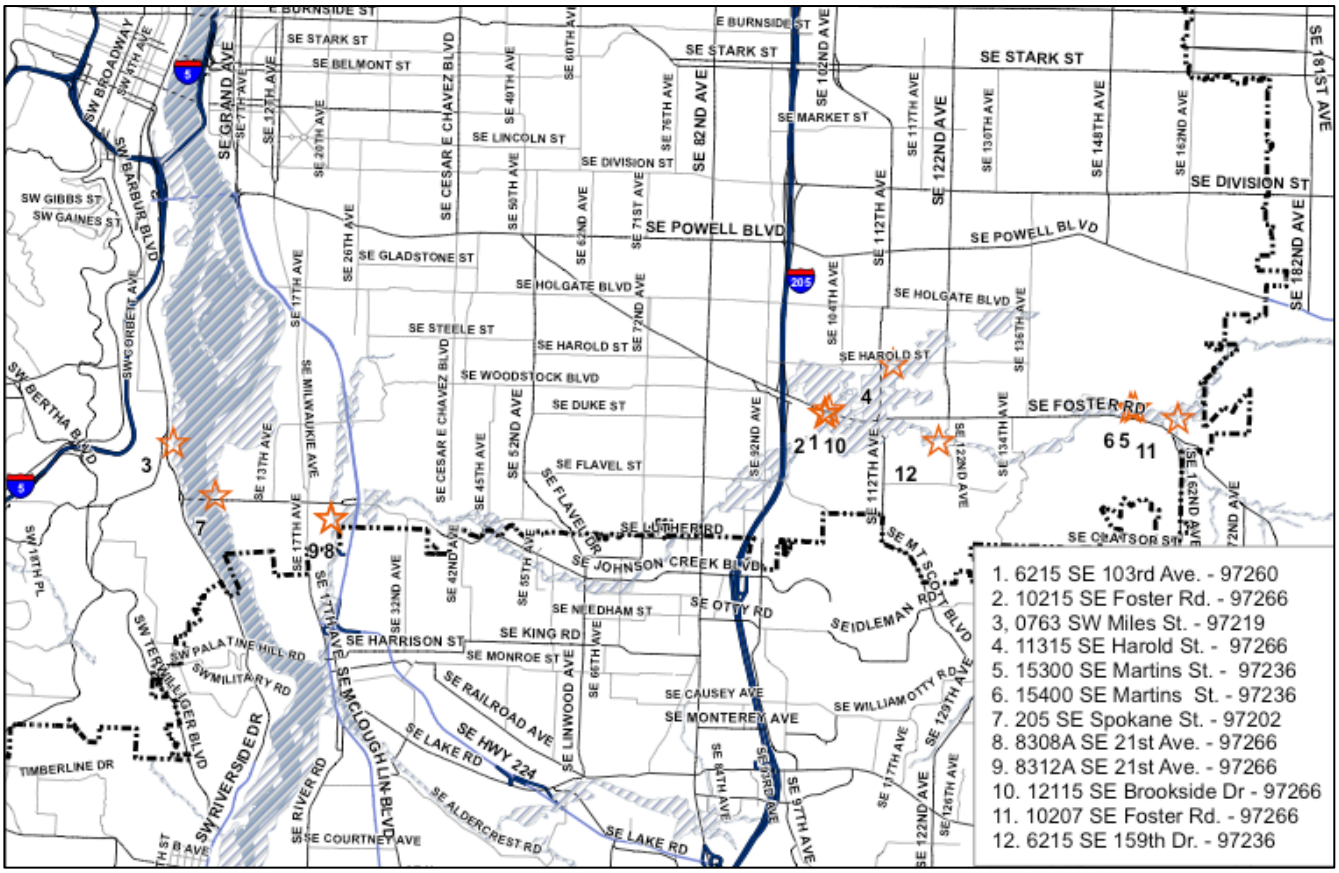
Table 4-3-1a Repetitive Loss Properties

Type (RL/SRL) Year(s)	Town	Occupancy	No. of Claims	Flood Insurance (Yes/No)	Value ($)[1]	Total Paid ($)[2]
Non-Mitigated Properties						
Property 1 RL 1@ 95,2@ 96	Portland, OR	Single Family	3	No	$88,020	$46,234.44
Property 2 RL 2@95,2@96	Portland, OR	Non Resident	4	Yes	$50,000	$53,601.89
Property 3 RL 96	Portland, OR	Single Family	2	Yes	$114,206	$91,501.06
Property 4 RL 2@96,1@09	Portland, OR	Single Family	3	Yes	$229,947	$17,323.54
Property 5 RL 2@95,2@96,1@09	Portland, OR	Single Family	5	No	$195,979	$125,859
Property 6 RL 1@95,2@96	Portland, OR	Single Family	3	No	$73,300	$21,864.06
Property 7 RL 96,97	Portland, OR	Non Resident	2	Yes	$433,800	$187,388.09
Property 8 RL 95,96	Portland, OR	Single Family	2	No	$96,500	$21,972.51
Property 9 RL 07,09	Portland, OR	2-4 Family	2	Yes	$454,195	$116,935.80
Property 10 RL 07,09	Portland, OR	Non Resident	2	Yes	$187,799	$79,168.75
Johnson Creek RL 09 (11 Properties)	Portland, OR	Unknown	187	Yes	$187,799	$2,500,000
Mitigated Property – acquired and demolished						
Property RL	Portland, OR	Single Family	5	No	$250,750	$180,301.99

Type includes: RL or SRL

[1]Insured structural value n/a.
[2]Content and building claims.

Figure 4-3-1a City of Portland Repetitive Loss Properties



4.3.2 Existing Critical Facilities and Infrastructure

- **Essential Facilities.** For the City, essential facilities include police and fire stations, City Hall, the 1900 Building, the Bureau of Emergency Communications and the Justice Center. Essential for the City means necessary for continuation of operations.
- **Critical Facilities and Infrastructure. "**Publicly and privately controlled systems and assets, including the built and natural environments and human resources, essential to the sustained functioning of the Portland/Vancouver metropolitan area including the Clackamas, Columbia, Multnomah and Washington Counties in Oregon and Clark County in Washington. Such systems and assets specifically include those necessary to ensure continuity of security, safety, health and sanitation services, support the area's economy and/or maintain public confidence. Incapacitation or destruction of any of these systems or assets would have a debilitating impact on the area either directly, through interdependencies and/or through cascading effects (Portland 2009g)." Critical infrastructure includes public services that have a direct impact on quality of life such as communication technology (phone lines or Internet access), vital services such as public water supplies and sewer treatment facilities and transportation facilities, such as

airports, heliports, highways, bridges, tunnels, roadbeds, overpasses, railways, bridges, rail yards, depots and waterways, harbors and dry docks.

- **Lifelines.** Lifelines include utility systems (potable water, wastewater, oil, natural gas, electric power facilities and communication systems) and transportation systems (airways, bridges, roads, tunnels and waterways). Communications facilities are also important lifelines.
- **High Potential Loss Facilities.** Facilities that would have a high loss associated with them, such as nuclear power plants, dams and military installations are included in the high potential loss facilities category. In Portland, this would include the hazardous materials sites in the NW Industrial area, the inner city dams operated by the Portland Water Bureau and critical infrastructure.

Foster Substation, 1996 flood

In 2007 the Portland Urban Area sponsored a review of critical infrastructure in the region. One of the outcomes of this process was to develop an agreed upon regional definition of critical infrastructure. The regional definition of critical facilities and infrastructure is in the list above. The sectors that were involved in developing this critical infrastructure definition represented the majority of the federal list of 18 identified sectors: Agriculture and food, commercial facilities, dams, energy, information technology, postal and shipping, banking and finance, communications, defense industrial base, government facilities, national monuments and icons, transportation systems, chemical, critical manufacturing, emergency services, healthcare and public health, nuclear reactors, materials and waste and water were all sectors considered in the Critical Infrastructure Protection Planning process of the Portland urban area. Not all of the national critical infrastructure and key resource sectors are represented within the region. One outcome of this planning process was a better understanding of interdependencies among the critical resources in the region. In particular, energy was identified as the most depended upon critical infrastructure and key resource in the region.

The next stage in plan development and identification of mitigation strategies will be in the American Recovery and Reinvestment Act Local Energy Assurance Plan process addressing the environmental impacts, community needs, economics of future technology in alternative fuel industry development and the response to energy outages.

Of the federal list of sectors, Portland has limited national monuments and icons, defense industrial base and nuclear reactors. This is not to say there are none, only that they are in very limited quantity. Although the private sector was invited to attend and participate, the food, banking and communication sectors which are privately owned were minimally represented. The 2010 City of Portland NHMP only references residential properties, government offices, emergency response, transportation, utility critical infrastructure and populations.

The critical facilities profiled in this plan include the following:

- Government facilities, such as city administrative offices, departments, or agencies.
- Emergency services facilities, including police and fire departments and emergency operations and communication centers.
- City, State and Federal transportation facilities (routes and warehouses).
- Utilities, such as electric power generation, fuel distribution, communications, water and waste water treatment.
- Fuel transmission pipes for natural gas, diesel, gas, bio-diesel.

Figure 4-3-2a Electrical Transmission System and Pipelines for Fuel and Natural Gas

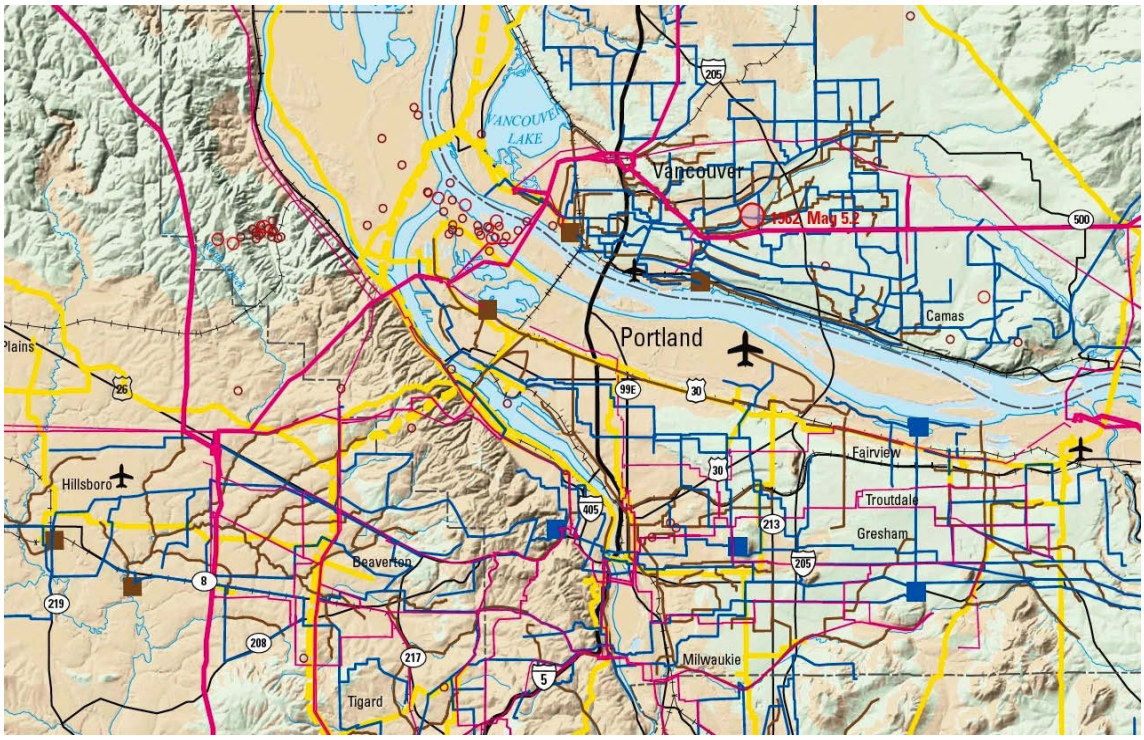


Figure 4-3-2b City-Owned Properties Map (Portland 2009h)

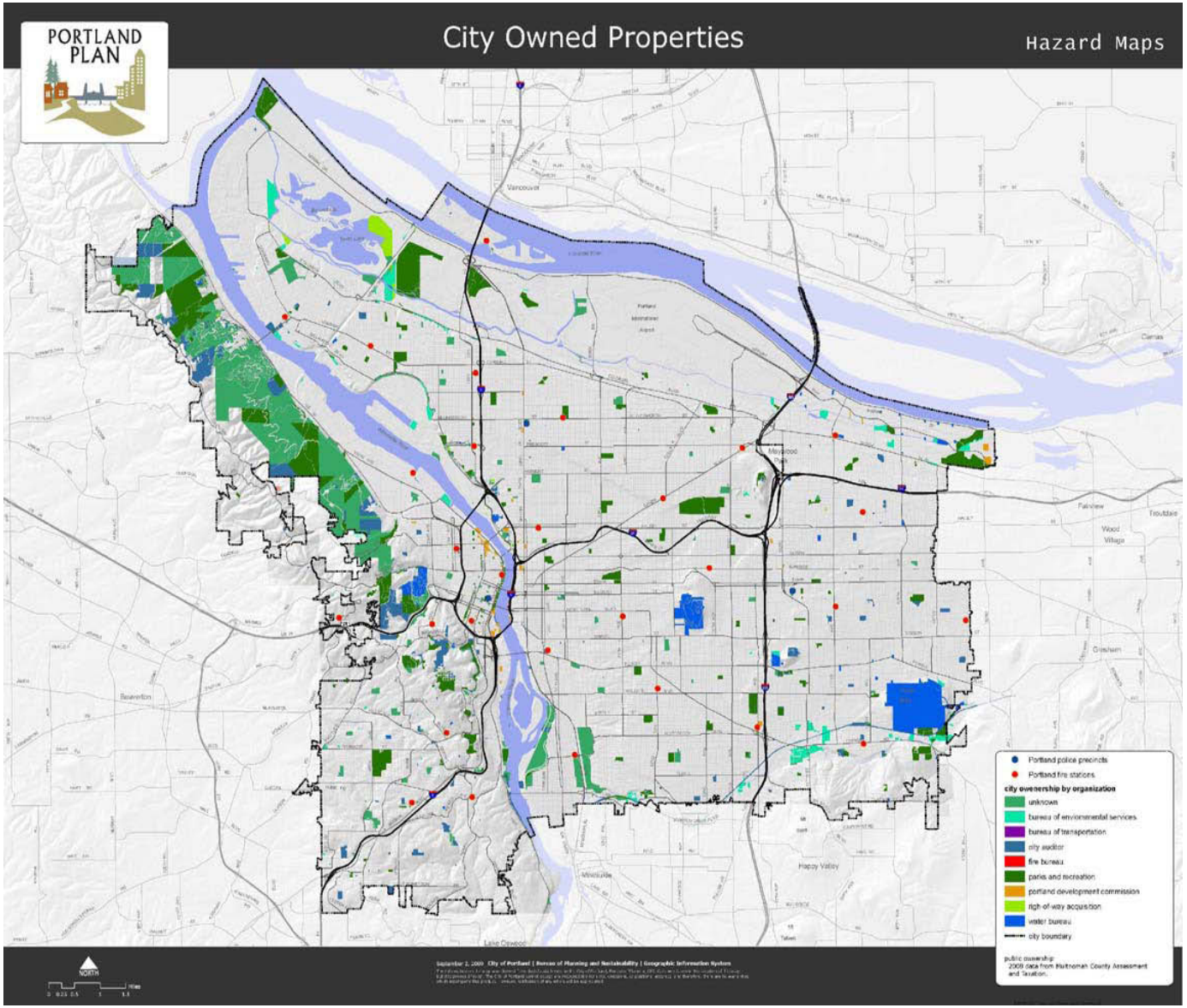


Table 4-3-2a City Properties

Facility Type	Bureau	Staff	Primary Facility	Replacement Cost ($)
Government Facilities	Auditor's Office	48	Main Office – City Hall	15,763,100
			Stanley Parr Archives & Records Center	3,549,170
	BDS	357	Main Office – 1900 Building	7,708,180
	Bureau of Environmental Services	524	Main Office – Portland Building	60,731,540
			Balch Construction Office	2,302,740
			Columbia Wastewater Treatment Plant	66,770
			Guilds Lake Complex	10,991,840
			Materials Testing Lab	
			Pump Maintenance Shop	
			Sellwood Construction Office	
			Tryon Wastewater Treatment Plant	
			Water Pollution Control Lab	17,296,930
	BOEC	140	911 Center	8.122.510
			Alternate: 911 Trailer	
	Cable	9	Main Office – Portland Building	
	City Attorney	52	Main Office – City Hall	
	Commissioner #1	9	Main Office – City Hall	
	Commissioner #2	6	Main Office – City Hall	
	Commissioner #3	9	Main Office – City Hall	
	Commissioner #4	7	Main Office – City Hall	
	FPD&R	17	Main Office – Harrison Square Building	
	Government Relations	7	Main Office – City Hall	
			Alternate: Salem Office	
			Salem Office	
	Housing	29	421 SW 6th	
	Human Relations	4	5315 N Vancouver	
	Mayor's Office	21	City Hall	
	Office of Management and Finance (OMF) (Overall)	669	Portland Building	
	OMF – BHR		Portland Building	
	OMF – BTS		Portland Building	

Table 4-3-2a City Properties

Facility Type	Bureau	Staff	Primary Facility	Replacement Cost ($)
			Comnet – 911 Center	
	OMF – Business Ops		Portland Building	
			Facilities	
			CityFleet	
			Motor Pool	
			Printing & Distribution	
	OMF – CAO's Office		Portland Building	
	OMF – Financial Services		Portland Building	
	OMF – Purchases		Portland Building	
	OMF – Revenue		Portland Building	
	ONI	38	Main Office – City Hall	
			Central Northeast	
			East Portland	
			Neighbors West/NW	
			Northeast Coalition	
			North Portland	
			Southeast Uplift	
			Southwest	
	PDC	200	222 NW 5th	
	Planning & Sustainability	120	Planning Office	
			Alternate: Sustainability Office	
			Sustainability Office	
			Alternate: Planning Office	
	Portland Office of Emergency Management (POEM)	15	Congress Center	
			Alternate: ECC	
			ECC	
			Alternate: Fire Training Facility	
	Portland Parks & Recreation (PP&R)	434	Central office	
			Children's Museum	958,130
			Columbia Pool	3,794,550
			Delta Park	3,963,900
			Gabriel Park	13,860,000
			Hoyt Arboretum	105,240,340
			Laurelhurst Park	1,238,380
			Lents Park	1,293,380

Table 4-3-2a City Properties

Facility Type	Bureau	Staff	Primary Facility	Replacement Cost ($)
			Park Ranger HQ	190,670
			Parks Operations	
			Peninsula Park	3,000,000
			Pittock Mansion	5,598,450
			Urban Forestry	3,963,900
			Washington Park – Rose Garden	2,545,300
			Westmoreland Parks	412,300
Emergency Response Facilities	Police Bureau	1285	Central Precinct	86,653,030
			East Precinct	7,836,020
			North Precinct	365,000
			Northeast Precinct	
			Southeast Precinct	3,545,240
			Others	
	Fire Bureau	756	Main Office Main Office – Temporary	10,353,090
			Fire Training Facility	2,305,530
			Station 01 – Downtown Core	
			Station 02 – Parkrose/PDX	
			Station 03 – NW Pearl	1,787,940
			Station 04 – PSU	1,677,320
			Station 05 – Hillsdale	833,260
			Station 06 – NW Industrial	764,850
			Station 07 – Mill Park	1,487,950
			Station 08 – Kenton	1,188,510
			Station 09 – Hawthorne	1,699,560
			Station 10 – Burlingame	1,391,890
			Station 11 – Lents	426,160
			Station 12 – Sumner	1,617,000
			Station 13 – Lloyd Center	1,116,680
			Station 14 – Vernon	
			Station 15 – SW Hills	399,620
			Station 16 – Sylvan	1,050,000
			Station 17 – Hayden Island	862,350
			Station 18 – Multnomah Village	86,270
			Station 19 – Mt. Tabor	51,810
			Station 20 – Sellwood/Moreland	877,420
			Station 22 – St. Johns	901,970
			Station 23 – Lower Eastside	1,596,990
			Station 24 – Swan Island	1,180,840

Table 4-3-2a City Properties

Facility Type	Bureau	Staff	Primary Facility	Replacement Cost ($)
			Station 25 – Woodstock	865,050
			Station 26 – U of P	967,450
			Station 27 – Forest Park/Forest Heights	1,124,240
			Station 28 – Rose City	248,020
			Station 29 – Gilbert	751,260
			Station 30 – Gateway	634,830
			Station 31 – Rockwood	693,430
Transportation Facilities	Portland Bureau of Transportation	802	Main Office – Portland Building	
			Maintenance	5,104,710
			Parking Patrol	
Utility Facilities	Bureau of Environmental Services	524	Main Office – Portland Building	
			Balch Construction Office	
			Columbia Wastewater Treatment Plant	
			Guilds Lake Complex	
			Materials Testing Lab	
			Pump Maintenance Shop	
			Sellwood Construction Office	
			Tryon Wastewater Treatment Plant	
			Water Pollution Control Lab	
	Portland Bureau of Water (Utility)	669	Portland Building	
			Interstate Facility	2,883,780
			Engineering/Operations/Lab	7,254,800
			Sandy River Station	

(Portland 2009)

Facility addresses are not listed for security reasons; replacement costs are only listed once because many offices are located in the same facility.

4.3.3 Future Critical Facilities and Infrastructure

The Portland Office of Emergency Management will advocate for the use of the regional definition for critical facilities and infrastructure and that greater attention be paid to private sector capabilities.

Critical infrastructure and the City's dependency upon it is of key importance to mitigation and resiliency planning and therefore will be focused upon as the city develops its Comprehensive Plan and implements energy reduction, sustainability and system strengthening practices to mitigate the loss of critical infrastructure and key resources.

The *Citywide Assets Report* (2007) delineates replacement value, current and physical condition and potential annual funding gaps. Information gaps exist due to unavailable information. In the 2007 report, two concepts were introduced as best practices: *risk management*, to address the City's infrastructure risks; and *green infrastructure* considerations to protect and improve the environment as part of the City's infrastructure core component.

If Portland is to reach the economic development strategy goal "…to build the most sustainable economy in the world", risks related to hazard impacts must be aligned within future management plans.

In the December 2008 Report, the Executive Summary listed the following information that portrays the City's future trends. (Note that best practices include risk analysis which measures consequence exposure extent from potential events.)

General Findings:

- The City's physical infrastructure has a current replacement value of $23.1 billion.
- An annual funding gap of at least $136 million exists between available funding and need.
- At current funding levels, some of Portland's infrastructure will continue to deteriorate.
- The risk of asset failure is a key measure and should be identified and reported in future asset reports. A risk management approach may also help inform management and funding decisions.
- The City's green infrastructure plays a key role in infrastructure services and should be accounted for similarly to traditional built infrastructure. Green infrastructure includes natural and engineered solutions and varies in the extent of City ownership.

Planning and Sustainability Director's Recommendations:

- Prepare a plan to guide continued improvement in citywide asset management best practices.
- Complete an evaluation of current citywide asset management practice.
- Identify key gaps based on research into best practices and bureau's unique needs.

- Prioritize improvements necessary to achieve best practices in asset management.
- Establish implementation steps and schedule.
- Build capacity to implement asset management best practices within capital bureaus citywide.
- Use asset management as a tool to improve decision making.

4.4 AREAS OF FUTURE DEVELOPMENT

Future Veteran Housing

The City seeks to protect its population by supporting State of Oregon initiatives, ordinances, building codes and development regulations. Oregon's Statewide Planning Goals and Guidelines Goal 7: Areas Subject to Natural Hazards is "To protect people and property from natural hazards". The goal establishes guidelines "In accordance with ORS 197.180 and Goal 2 state agencies shall coordinate their natural hazard plans and programs with local governments and provide local governments with hazard inventory information and technical assistance including development of model ordinances and risk evaluation methodologies. Local governments and state agencies shall follow such procedures, standards and definitions as may be contained in statewide planning goals and commission rules in developing programs to achieve this goal."

The 2010 City of Portland Natural Hazard Mitigation Plan is the document that provides a process and plan for tracking the actions that work toward this goal. The mitigation actions have their own initiatives and codes established or that will be established to allow implementation of their project plans. Through Title 33, Planning and Zoning, Chapter 33.500, Plan Districts sections states that "The City restricts new development in known hazard areas." The codes used to evaluate hazard resilience of properties to be developed will be analyzed as the 2010 NHMP is implemented as will the alignment of mitigation actions in the various projects that address future development.

Future analysis of specific areas will include greater detail of the environment, demographics, structures used for service, commercial and residential, infrastructure and the hazards. This review will aid in a more definitive spatial analysis of buildable land. A study of buildable land inventory is a part of the Comprehensive Plan update and hazards are currently integrated into the analysis.

Hazard Exposure Analysis in Relationship to Residential and Non-Residential Structures

The results of the exposure analysis are presented in Table 4-4-1a and 4-4-1b. Average structural value of all residential buildings including single-family dwellings, mobile homes, etc., is $267,100 per structure. Population by parcel was not available at the time this document was prepared. A useful analysis of population and residential structures by hazard can be completed by analyzing information from the Portland Plan Background reports superimposed upon the hazard areas and their potential impact.

Table 4-4-1a reveals the amount of information the 2010 Portland Hazard Analysis needs to assimilate in regards to assets and their exposure to hazards. This data will be examined by bureaus in the 2010-2015 review period. The table was developed by URS GIS department by overlaying Portland owned property, by address, onto hazard layer maps. Greater definition needs to be gathered on actual population and structures within hazard areas. The city population is not evenly distributed but that Central City has 3% of total population, NE Portland =19%; East Portland = 21%, SE = 28%, W = 18% and North = 10%. Hazard exposure analysis needs to account for nature of hazard as well as population concentration.

Portland Hazard Exposure Analysis Summary Population and Buildings

Table 4-4-1b is a review of the insured structural value of all critical facilities. These values can be understated as not all critical facility values were available during this vulnerability analysis. Population by facility was not available at the time this document was prepared.

Sylvan Fire Station #16

Table 4-4-1a Estimated Hazard Exposure Analysis Summary for Portland Population and Buildings

Hazard Type 145 sq. miles or 92,800 acres = total area	Hazard Area Impact % of property damaged	Methodology Magnitude, level, degrees or rank	Population Number Total 582,130 relative to % property exposed	Buildings			
				Residential		Non-Residential	
				Total Number units 253,971	Value ($)[1] unit x average value of $267,000	Total Number buildings 212,476	Value ($)[1] no average $ known
Earthquake 60% of all buildings built prior to 1978	Strong – 5%	9-20% (g)	17,464	7,619	$101,713,650	6,374	Undetermined
	Severe -25%	>40-60% (g)	87,320	13,095	$874,091,260	31,871	Undetermined
Severe Weather	Severe -25%	Descriptive	145,532	63,493	$4,238,157,750	Undetermined	
Flood 7,104 acres of water	Strong – 5%	100-year floodplain	4,062	1,625*	$21,693,150	Undetermined	
	Severe – 25%	500-year floodplain	11,194	4,884	$326,007,000	Undetermined	
Wildfire 32,162 acres of forest	Strong – 5%	Low fuel rank High fuel rank	9,702	4,233	$56,510,550	Undetermined	
	Severe – 25%	Very high fuel rank Extreme fuel rank	48,511	19,404	$1,295,217,000	Undetermined	
Landslide ?% of land	Severe – 25%	>32-56 degrees	26,892	11,255		Undetermined	
Erosion 25% total water acreage	Severe – 10%	within 300' of potential erosion areas	4,062	1,625	$43,378,500	2,124	Undetermined
Invasive Plant Species 4,181 – 12,864 acres	strong - 7%	descriptive	40,749	17,778	Not applicable		
Volcanic Activity	severe	Descriptive	582,130	Undetermined			

2010 Special Flood Hazard Area FIRM identified properties within 100 year flood; no calculation for 500 year flood plain made.

Estimates in this table are based on % of total acreage/exposure (area) affected by specific hazard and the % of impact minus % of area (pop X %impact) = # population exposed; % area (units X %impact) = # of units exposed; %impact X average unit cost X # units exposed = estimated cost of exposure. A comprehensive inventory of environment, demographics, structures both commercial and residential, infrastructure and hazards will be complete in the 2010-2015 review as part of the hazard vulnerability assessment. The numbers above are non-confirmed estimations.

Table 4-4-1b Estimated Hazard Exposure Analysis Overview of City Owned Critical Facilities

Hazard Type	Hazard Area	Methodology	# Staff T = 1362	Value ($)[1] T = $117.1 million	# Staff T = 2181	Value ($)[1] T = $304 million	# Staff T = 802	Value ($)[1] T = $7.9 million	# Staff T = 119	Value ($)[1] T = $11.3 million
Earthquake			assume 10% exposed		assume 30% exposed		assume 49% exposed		assume 86% exposed	
	Severe	>40-60% (g)	136	$11.7 million	654	$91.2 million	393	$3.87 million	102	$9.7 million
Severe Weather	Strong -25%	Descriptive		NA	545	$2.2 million	200	$967,000.	30	$2.4 million
Flood	Strong – 5%	100-year floodplain		NA	37	$3.3 million.	40	undetermined	6	$4.8 million
	Severe – 25%	500 -year floodplain		NA	189	$16.9 million (25% of $67.6m)	200	undetermined	30	$2.4 million
Wildfire	Strong – 5%	Low/high fuel rank		NA	37	$3.3 million		NA	6	Undetermined
	Severe – 25%	Very High Extreme fuel rank			189	$16.9 million		NA	30	Undetermined
Landslide	Severe – 25%	>32-56 degrees		NA		NA	200	$967,000.	30	$2.4 million
Erosion	Severe	within 300' of potential erosion areas	NA			NA		Undetermined		Undetermined
Invasive Plant Species	Strong	Descriptive	NA	NA		NA		Undetermined		Undetermined
Volcano	Severe	Descriptive		Undetermined		Undetermined		Undetermined		Undetermined

Calculations are based on 2008 Asset Management Report for Portland's critical facilities and lifelines; Not included are Parks and Recreation facilities, civic facilities, offices not located in the Portland Building, 1900 Building or City Hall; Utilities include all water, sewer, combined sewer and wastewater treatment facilities, pumps and piping network; transportation includes all facilities listed in the Asset Management Report; Emergency Services includes all police and fire stations, the 911 center and all technology associated with communication.

Exposure relates to building condition as identified in the 2008 Asset Management Report. Total exposure - % of average facility condition in grouping = amount of exposure potential. *Utilities' high exposure rate is due to the scores given to the water systems in the Asset Management Report

4.5 SUMMARY OF VULNERABILITIES AND IMPACTS FROM IDENTIFIED HAZARDS

The 2004 Hazard Vulnerability Analysis was conducted through a FEMA pilot using a software program HAZUS- MH. This can be viewed on line at www.portlandoregon.gov/oem. In 2006 Oregon Emergency Management required a FEMA compliant Hazard Vulnerability Analysis be completed by all federally funded emergency management agencies in Oregon. The combination of these two emergency management based reports combined with the information included in the Portland Plan background reports and hazard specific reports establishes a comprehensive review of land use and hazards. The following section provides a summary of city vulnerabilities and impacts from natural hazards.

- Portland is subject to substantial natural hazard risks. Of the 1,928 "major disaster declarations" in the US between 1953 and 2009, the State of Oregon has claimed 26, ranking it 33rd in the number of disaster declarations for any state or territory. Total aggregated losses from natural disasters in Oregon have reached into the hundreds of millions of dollars during the past decade. Portland has had one federally declared disaster as a result of the flood of 1996.
- Seismic activity, heavy precipitation, weather extremes and geography will continue to result in earthquakes, floods and landslides. In addition, periods of long dry summers and fuel accumulation (tree, grass and understory growth) contribute to the potential for wildfires.
- During the winters of 1996 and 1997, the Portland area experienced floods, landslides and ice storms. Over $220 million was provided to Oregon under several federal relief programs for three flood and landslide disasters that occurred in 1996 and 1997. Portland claimed over $60million in damage due to the floods and landslides.

2004 HAZUS MH reported assets within the City of Portland in excess of $59 billion, including residential and commercial structures and building content, public and private critical facilities and infrastructure (utilities and transportation lifelines). The 2010 City of Portland NHMP only references residential properties, government offices, emergency response, transportation, utility critical infrastructure and populations. This data will be subject of research during the 2010-2015 review.

- Areas along the Willamette River include flood zones, landslide potential, liquefaction potential, soft soil areas and significant development. The multiple hazard areas along the river, combined with the level of development, appear to indicate that this area may face greater risk of losses than other areas of the study region (Portland 2004). Erosion now is most evident along the Willamette River and is affected by increased river traffic and the resulting wakes from the boats.

The following hazard-specific information is derived from the best available data for facility locations and values. In many cases, values were unavailable and therefore the totals listed should be considered incomplete and likely less than the actual costs associated with the respective hazards.

Earthquake

An analysis of the USGS Peak Ground Acceleration (PGA) shake maps reveals that the City is likely to experience very strong shaking, as a result of its proximity to the Cascadia Subduction Zone. Ground movement is likely to cause damage to weak, unreinforced masonry buildings and to induce small landslides along unstable slopes. Earthquakes can trigger other hazards such as fires, dam failure and transportation and utility system disruption.

The 2006 Hazard Vulnerability Analysis assessed Portland's earthquake hazard as low historically (0-1 event in last 100 yrs), high vulnerability with more than 10% of population and property likely affected, a high percentage (25%)of the population and property that could be affected and the likelihood of future occurrence within the next 35 to 75 years. Total points given to earthquake were 215.

Not all facilities will be impacted the same. City of Portland has been seismically strengthening fire stations, City Hall, the 1900 Building and utility facilities. Not all facilities are the same age, consequently buildings built after 1978 adhere to more stringent building codes.

Severe Weather

Loaves and Fishes Meal Delivery, 2008

The natural hazards resulting from severe weather events, such as weather pattern changes, drought, ice, snow, cold, wind and floods are often widespread. Climate change and ENSO characteristics cause weather pattern variations throughout the City and across the entire State of Oregon. El Niño periods are generally drier, with an increased likelihood of drought, while La Niña periods tend to be wetter and colder, with an increased risk of winter storms and rain events and the associated hazards they bring, particularly flooding and landslides.

Portland has many micro-climates, hills and valleys and the Columbia Gorge that all contribute to weather possibilities. With major transportation routes that could be affected by ice and snow, bridges and hills to cross to get from one part of the city to the next and the economic impact of road closures, the vulnerability of the City to the winter temperatures is an every year reality.

The impact of climate change and ENSO are on a very large scale, so it is difficult to quantify their effects locally. Instead, ENSO is manifested in the hazards it influences, such as winter storms, flooding, landslides and drought. Therefore, the facilities impacted have been summarized under those categories.

Structural damage from drought is not expected; rather the risks are present to humans and resources. Agriculture, fishing and timber have historically been impacted, as well as local and regional economies. "Although the City of Portland has suffered periods of drought in the past, the impacts have not been severe enough to reach major emergency or disaster proportions." (Portland Hazard Analysis, 2006)

Many buildings, utilities and transportation systems in open areas, natural grasslands, or agricultural lands are especially vulnerable to wind damage. Impacts associated with wind can include tree and structure damages and temporary power disruptions.
Historically, severe weather has had a major impact on the City. The City is vulnerable to high winds, black ice and snow. FEMA awarded $452,000 to the City and Multnomah County in response to a 19-day ice storm and cold snap event during the 2003-2004 winter season.

"Severe weather is the hazard of most significance to the Portland area because of its reoccurrence. It received high points in all categories 1) historic occurrences of over four events in the last 100 years, 2) vulnerability level is over with 25% of the population likely affected by a storm, 3) over 25% of the population and property could be affected in a worst case scenario and 4) the probability of a severe weather occurrence is an incident likely within ten to thirty-five years. "(2006 Portland Hazard Analysis)

Therefore, all critical facilities, infrastructure and population are at risk from severe weather impacts. The structural damage to these buildings historically has been minimal. The assessment of facilities is complex and broad geographically so a summarized calculation of cost is disputable. Damages incurred from a severe winter weather event would include electrical complications, water damage, trees down on top of facilities and home. The economic impact of a storm has many factors to consider including immediate and residual effects of the impacts on service delivery.

Flood

Historically Portland has floods over four times in a 100 year period, 1-10% of the population will most likely be affected by flood, over 25% of the population could be impacted in the worst case scenario of a flood and the probability of one flood event occurring within 10 to 35 years is high. Flooding is the second most frequent emergency in Portland.

- FEMA Flood Insurance Rate Maps (FIRMs) were used to outline the 100-year and 500-year floodplains for the City. The 100-year floodplain delineates an area of high risk, while the 500-year floodplain is described as an area of moderate risk. A 100-year flood has a 0.01 or 1 percent chance and a 500-year flood has a 0.002 or 0.2 percent chance of being exceeded in any one year.
- The 2004 HAZUS-MH computer analysis methodology identified that 29,000 people live within the impacted area for a 100 year flood event. This data is inconsistent with other data sources and will be the subject of research during the 2010-2015 review as part of the hazard vulnerability assessment.
- Nineteen hazardous material sites are located within the 100 year flood plain.

- Three billion dollars of commerce is protected by the Multnomah County Drainage District system of dikes along the Columbia River.
- The Flood Insurance Study conducted by the Federal Emergency Management Agency (Flood Insurance Number 410183V000B) January 2010, serves as the basis for Flood Insurance Rate Maps. This study does not include the impact of the 1996 flood nor the amount of construction which has occurred in the Portland area later than 1977. This is also the document that the buildable land inventory for the City is based on concerning property in flood plain areas.

Under review in the next hazard analysis will be the2004 HAZUS-MH estimation of loss:

- Eighty electrical substations are at risk from a 100 year flood.
- Impact on bridges and transportation routes and government facilities.
- Not all structures will be impacted totally so the total value stated is an over estimate.

Landslide

The potential impacts from landslides can be widespread. Potential debris flows and landslides can impact transportation and rail routes, utility systems, and water and wastewater treatment infrastructure along with public, private and business structures located adjacent to steep slopes, along riverine embankments, or within alluvial fans or natural drainages. Response and recovery efforts will likely vary from minor cleanup to more extensive utility system rebuilding.

Utility disruptions are usually local and terrain dependent. Damages may require reestablishing electrical, communication and gas pipeline connections occurring from specific breakage points. Initial debris clearing from emergency routes and high traffic areas may be required. Water and wastewater utilities may need treatment to quickly improve water quality by reducing excessive water turbidity and reestablishing waste disposal capability.

Landslides are common in Portland because the area has steep slopes, abundant precipitation and in some areas weak soils. Landslides in the Portland area occur primarily in four areas. More than half of the 700 slides that occurred during 1996 were in the Portland West Hills where weak, silt-rich soils become easily saturated and fail, resulting in earthflows. A second area of concern includes the steep slopes along the Willamette River such as Oaks Bottom and Swan Island. These landslides tend to be thin but numerous, and many are human-caused when garbage and yard debris are dumped over the edges of the slopes. In southeast Portland, reactivation of ancient landslides is a large problem on deposits of the fine-grained Troutdale Formation sediments. The fourth landslide prone area includes the steep creeks along the Columbia and Willamette Rivers where debris flows occur. Examples are Dodson in the Columbia Gorge and Germantown Road in northwest Portland.

According to the 2004 HAZUS-MH, approximately 66,400 people (28,800 households) are potentially exposed to landslides in the Portland area. Special needs populations (the elderly and low income populations) are not disproportionately impacted. More than $8.8 billion dollars in commercial and residential property is exposed to the impact from landslides. Some critical facilities are exposed to landslides; 46% of potable water treatment plants, 30% of hospitals,

and 18% of fire stations in Portland are exposed. Under review in the 2010-2015 hazard analysis will be the 2004 HAZUS-MH estimation of loss due to earth movement and landslide.

Erosion

This is a newly identified hazard so impact information is unavailable at this time. Collecting this data will require a multi-bureau coordinated effort that will be completed during the 2010 -2015 review process.

Riverine erosion rarely causes death or injury. However, erosion can cause destruction of property, development and infrastructure. Erosion hazard data is not readily available but descriptions of several localized areas were identified during the development of this document.

Wildfire Urban Interface Fire

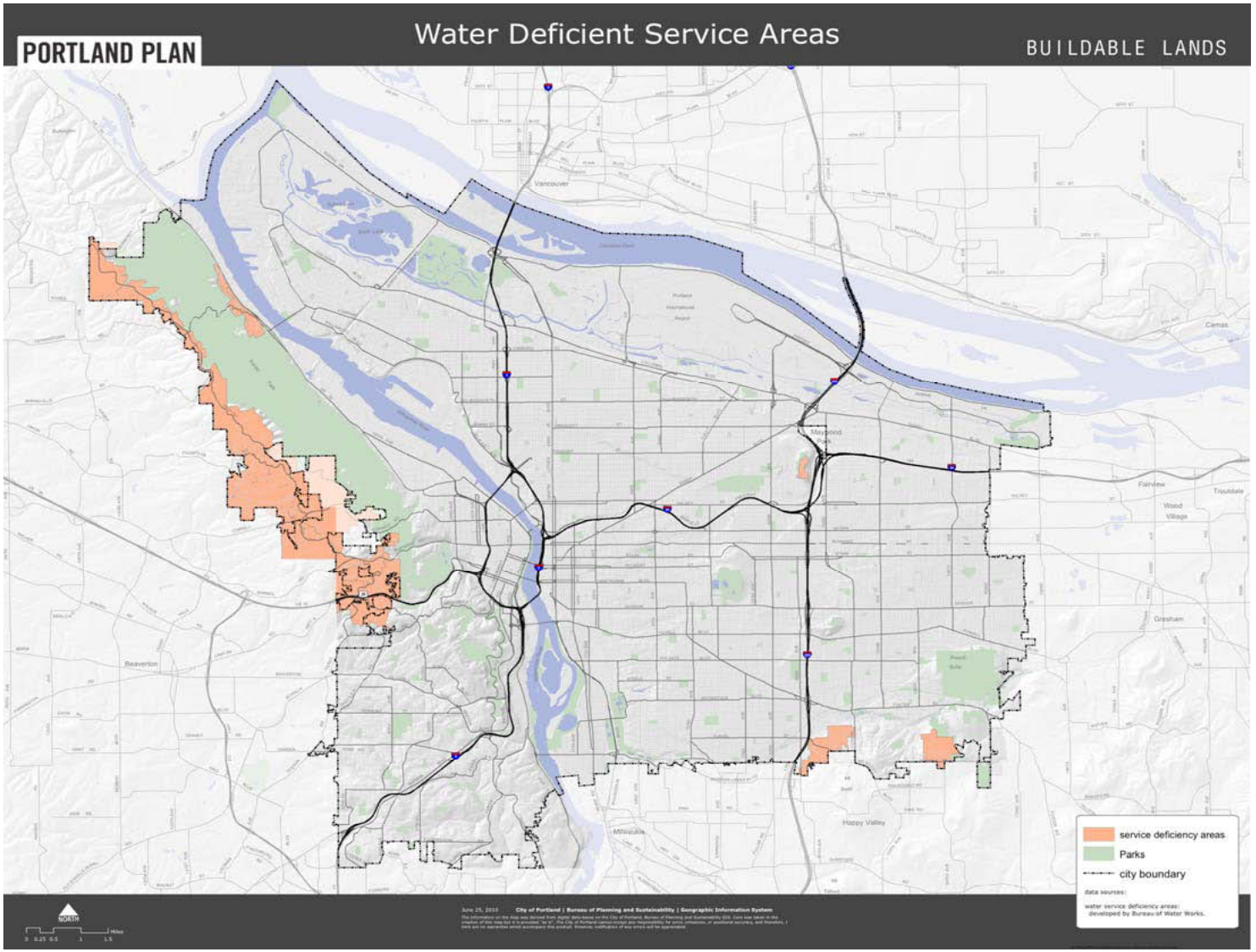
Wildland urban interface fire hazard areas are identified using fuel load (vegetation conditions), topography (land slope), weather (especially temperature, wind and humidity) and the built environment. Non-native vegetation and invasive plant species that are poorly adapted to local climate conditions dry out faster and ignite more easily than species native to our region. Portland contains moderate, high, very high and extreme fuel loads. South-facing, steep and heavily vegetated areas contain the highest fuel risks. Steep slopes allow wind driven fires to grow more intense and spread rapidly. Areas with little slope and natural vegetation are the lowest fuel risks. Even short periods of high temperatures, low humidity and winds above 10 mph can cause significant increases in fire risk. Climate change is also a concern due to the increased susceptibility of vegetation to fire due to longer dry seasons. Houses dot the west hills and neighborhoods line the river's bluffs and climb the slopes of our forested buttes. Over 8,000 homes and businesses worth more than $2.5 billion lie within the fire prone area.

In Portland, twenty percent of the city's acreage is urban greenspace – natural areas, stream corridors, parks, and open spaces. A large proportion of the natural area consists of Forest Park, a 5,100-acre wildland reserve situated in Portland's West Hills, Powell Butte, Willamette Bluffs Escarpment, Marquam nature Park, Terwilliger Wildlands, Kelley Butte, Rocky Butte and Mt. Tabor. Portland Fire & Rescue, with the assistance of Oregon Department of Forestry, has identified and mapped each of these sites as high risk fire prone areas because of their buildup of flammable materials and their proximity to neighborhoods and commercial areas. As development continues to expand at the boundaries of these urban natural areas, the risk of significant property loss due to wildfires increases.

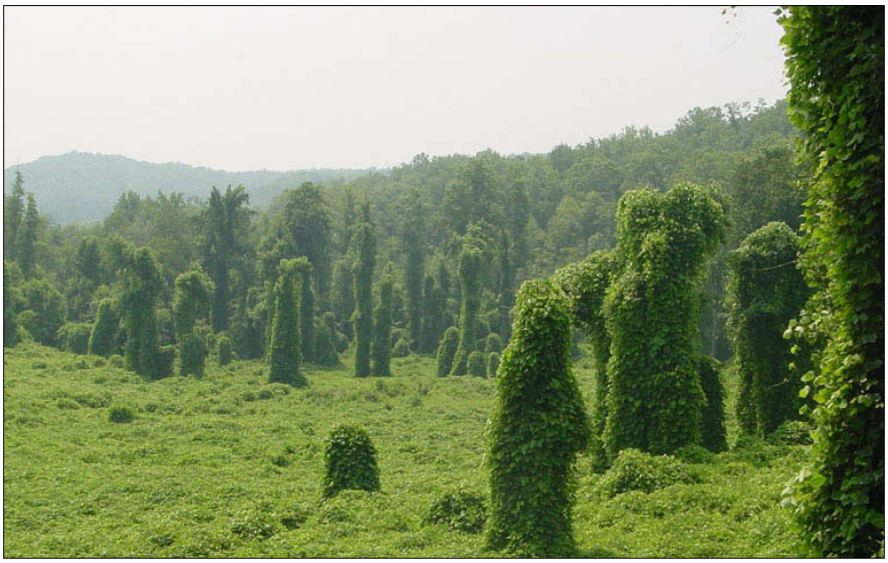
The 2006 Portland Hazard Analysis ranks wildland urban fire 6th through the OEM methodology. Wildland urban fire has occurred more than four times in the last 100 years in Portland, less than 1% of the population would be affected by a normal wildland urban fire event, but over 25% of the population could be affected in a worse case scenario. The probability of a wildland urban interface fire occurring though is maybe one incident in 35 to 75 years.

- An analysis of 2004 HAZUS-MH information will be conducted in the 2010 - 2015 review process to verify assets at risk to wildland urban interface fire.

Figure 4-5a City of Portland Water Deficient Service Areas



Invasive Plant Species



Invasive Kudzu overtaking native forest

The Portland Plant List, lists 163 plant species divided between the City's adopted Nuisance Plant List and the Prohibited Plant List. Invasive plants are a problem in Portland as they exacerbate hazard impact such as erosion, landslide and wildfire.

An evaluation of vulnerability to City facilities, infrastructure and private properties will be a part of the 2010-2015 review. Currently their can only be very gross estimations of the cost of loss due specifically to invasive plants.

Volcanic Activity

The City will likely only experience damage from volcanic eruption columns and clouds that contain volcanic gases, minerals and rock. The columns and clouds form rapidly and extend several miles above an eruption. Solid particles within the clouds present a serious aviation threat, can distribute acid rain (sulfur dioxide gas and water), can create risk of suffocation (carbon dioxide is heavier than air and collects in valleys and depressions threatening humans and animals) and pose a toxic threat from fluorine which clings to ash particles potentially poisoning grazing livestock and contaminating domestic water supplies.

Buildings, streets and roads throughout the entire City would require minor cleanup with negligible impacts. Temporary utility interruptions are likely and minor cleanup may be required for electrical and other utility services. Water treatment facilities may be required to address highly turbid water. Columbia and Willamette River traffic could be impacted by sediment deposition from a large Mt. St. Helens or Mt. Hood eruption. Channel dredging to restore acceptable depths could be required after such an incident. Health complications associated with respiratory problems may also result.

"The City of Portland "faces no direct threat" from volcanic eruption. Direct threat according to USGS means directly affected by lava flows, pyroclastic flows or lahars. However, its proximity to a number of Cascade Range volcanoes places the region at risk from ash fallout originating from such an event. In 1912 volcanic cinders were found in Mt Tabor Park within the City limits. The City also faces an indirect threat to its water supply based on a volcanic scenario impacting the Bull Run water system." (2006 Portland Hazard Analysis)

Therefore all critical facilities, infrastructure and population are at risk from volcanic ash fall impacts. The impact will be minimal to structures but air quality and mechanical operations will be impaired.

4.6 LAND USE AND DEVELOPMENT TRENDS

DMA 2000 Recommendations: Risk Assessment, Assessing Vulnerability, Analyzing Development Trends

Requirement §201.6c2)(ii)c The plan should describe vulnerability in terms of] 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.

4.6.1 Development Regulations

Portland's Comprehensive Plan currently outlines goals, policies and actions regarding natural hazards in Portland. Policies designed to meet the State's comprehensive planning requirement, Goal 7 of the "Areas Subject to Natural Disaster and Hazards" include the provision of safe housing, regulating development in areas subject to flooding and providing emergency response route networks for first responders.

Portland has adopted a number of regulations regarding development in areas subject to natural hazards.

The City has overlay zones that are established citywide; these overlay zones focus on protecting identified natural areas and meeting statewide planning goals. For example, the City's Environmental Overlay Zone and the Pleasant Valley Natural Resource Area Overlay Zone protect sensitive habitats such as terrestrial and aquatic environments. The Greenway overlay Zone protects the riverbanks of the Willamette River. These overlay zones include parameters for the nature and extent of allowed development and include hazard area of flood, landslide, erosion and wildland urban interface fire.

Landslide hazards are mapped on the Potential Landslides Hazard Map and the Rapidly Moving Landslides Map. In general, much of the provisions regarding geotechnical requirements are identified in building codes and implemented by the City's Site Development staff in the Bureau of Development Services. However, there are also specific provisions in the Zoning Code (Title 33 of Portland City Code) in the Land Divisions and Planned Developments Section. Chapter 33.632, Sites in Potential Landslide hazard Areas, states "The approval criterion for lands subject to landslide will help minimize public and private losses as a result of landslides." The approval criteria apply to all proposals for Land Divisions where any portion of the site is within a Potential landslide Hazard Area.

The approval criterion includes: "Locate the lots, buildings, services and utilities on the safest part of the site so that the risk of a landslide affecting the site, adjacent sites and sites directly across a street or alley from the site, is reasonably limited." In addition, "Determination of whether the proposed layout and design reasonably limit the risk of a landslide will include

evaluation of the Landslide Hazard Study and will take into consideration accepted industry standards for safety. Alternative development options including alternative housing types and reduced density may be required in order to limit the risk to a reasonable level." All building permits submitted to the City are reviewed by site development staff.

In 1992, the Portland region adopted the Metro charter and a Regional Framework Plan. The charter directs Metro to address regional transportation and mass transit systems, protection of lands outside the urban growth boundary for natural resource, future urban or other uses, housing densities, urban design and settlement patterns, parks, open spaces and recreational facilities and water sources and storage.

The Metro Council's Resolution Number 99-2820 "encourages all local jurisdictions in the Metro region to actively protect environmentally sensitive areas, even if they include Urban Growth Boundary inventory lands that Metro is required by state law to classify as 'buildable.'"
By including information about hazards relative to neighborhood characteristics, vulnerable populations, access to resources, jobs and transportation, in the 2010 Portland Plan and the Comprehensive Plan, the City will be taking steps to assure that hazard and risk analysis are a part of the criteria for development decisions in the next 25 years.

4.6.2 Planning

Planning for natural hazards is an integral element of Oregon's statewide land use planning program, which began in 1973. All Oregon cities and counties have comprehensive plans and implementing ordinances that are required to comply with the statewide planning goals. The challenge faced by state and local governments is to keep this network of local plans coordinated in response to the changing conditions and needs of Oregon communities.

Local jurisdictions are primarily responsible for developing and implementing risk reduction plans, strategies and policies. State and federal resources are available including OEM, Oregon Building Codes Division (BCD), Oregon Department of Forestry (ODF), DOGAMI and the Department of Land Conservation and Development (DLCD) (Portland 2004).

The intention of the 2010 NHMP is to link existing land use and project plans, further emphasizing the city's active role in hazard mitigation through everyday activities and long range planning.

4.6.3 Land Use

The amount of buildable land within lands zoned for particular uses such as residential, commercial, industrial and open space is valuable information for future development of Portland. A part of the update of the Comprehensive Plan will be a review of the buildable lands as they relate to various hazards. A review of hazard maps will be a part of the determination. One of the action items in the 2010 NHMP is to create a multiple bureau mapping committee to verify hazard areas and the metrics of city maps. In this way the determination of land use can be referenced on an agreed upon standardized hazard map. Greater use of Light Detection and

Ranging technique for mapping land forms such as historic landslides and stream beds will allow more defined hazards through scientific visual presentation.
Defining land use zones is important to develop a livable city. The zoning determines what can and cannot be built in an area, to what codes the buildings need to be built and establishes standards that allow the City to grow in a manner that takes into account safety, livability, infrastructure availability and connectivity between urban and open space forms. For example, industrial lands potentially contain hazardous materials where spills exacerbate hazard impacts and which in turn, if high density housing or commercial use sites are established nearby, could cause greater risk to life and property. The proximity of population to hazard locations, steep slopes, floodplains, hazardous materials sites, creates a greater potential for loss. Another example would be the availability of resources in a commercial area to the residential area and how the transportation systems connect the two zoned areas.

Each area of Portland has specific characteristics that dictate its urban form. In the western neighborhoods are shaped by hilly terrain. Inner neighborhoods are defined by an extensive system of main street commercial districts and high density. Eastern neighborhoods have poor street connectivity in many places with automobile-oriented strip commercial developments. Central city is the most intensely urbanized, reflecting the roles regional center for finance, commerce, government and culture. The Industrial districts are concentrated in low-lying riverfront areas with building areas shaped by railroads and rail spurs. (Portland Plan Urban Form Background Report)

The zoning designations which create, designate and accommodate the different topographic form, however, do not necessarily represent the actual amount of development that falls into each category. As shown in the asset inventory portion of this document (4.2.1) the zoned areas of Portland do not necessary mean that they are developed fully to that zoned use.

4.6.4 Housing

Housing

Understanding the City's current housing stock as well as community development trends is essential to hazard mitigation planning. Development and population growth will directly influence the impacts of natural hazards.

Older housing stock can be more susceptible to hazard event damage, especially if it was built prior to newer building codes. For example, housing stock built before 1940 (35 percent) remains as the City's most susceptible to earthquakes and severe weather event impacts. About 25% of the housing was built in the time period 1940-1960. "As this constitutes over half of the City's housing supply, adequate and appropriate maintenance of aging units is required to upkeep the existing housing supply."

Potential injury threats increase if vulnerable populations live in older housing. These residents are less likely to have the physical capability or financial resources to respond to, or recover from, a devastating disaster event.

The total housing units as of 2008 is recorded at 249,928. "An examination of housing stock within the City's geographic subareas reveals differences in *number* and *nature* of the housing units within its geographic clusters. Interestingly, Southeast Portland, which covers approximately 15% of the City's land area contains an estimated 29% of the City's total housing stock. Three other subareas, the Northeast, East and West Portland each account for roughly 18 percent of the total stock. The North subarea holds nearly 10% of the total units while Portland's Central Business District (CBD) accommodates just over 4% of the City's housing units." (Portland Plan Housing Supply Background Report)

Historic Bagdad Theater, SE Portland

Buildings

The Portland Plan Historical Resources Background Report reviews data available on the age of buildings in Portland. Portland is divided into quadrants, based on the geography of the city. The "quadrants" actually represent five areas: North, Northeast, Northwest, Southeast and Southwest. Information for 90% (193,160) of Portland's building stock was available for review. Citywide, the largest percentage of buildings were constructed between 1935 and 1960 (28%), closely followed by buildings constructed after 1960 (27%). North Portland has the highest percentage of buildings built in or before 1910 (13%) and more than half (56%) of buildings in the area were built between 1911 and 1960. Northeast has a slightly higher percentage of buildings built between 1911 and 1960, 63%. This trend is reflected citywide; 52% of buildings were constructed between 1911 and 1960. Northwest has the highest percentage of buildings constructed after 1960, 37%. However, it also has the highest percentage of buildings for which no data is available (29%). The central city area, downtown, has the greatest number of building built in or before 1910. The source of the data is the Multnomah County Assessment and Taxation, 2008 & 2002.

4.6.5 Employment and Industry

The Economic Opportunities Analysis report created to inform the Economic Development background report of the Portland Plan establishes facts about Portland's economy.

- Portland is still the regional jobs hub (with 40% of the region's total jobs in 2006)
- The share of the region's new jobs coming into Portland has been dropping – to 11% in 2000–2006 from 27% in 1980–2000
- The exception to this trend has been Central City, where jobs rose 12,000 from 2000–2006, compared to the city overall losing 7,000 jobs in the same period. In other words, Central City job growth is responsible for Portland's net job gain of 5,000 from 2000–2006

- Recent job growth (2000–2006) in the three-county region has been primarily in institutional and office sectors – especially in health care (up 17,000 jobs) – not in industrial or retail sectors
- Metro regional government forecasts 520,000 new jobs by 2035 in the Portland Metro seven-county region (the Metropolitan Statistical Area, or MSA). That amounts to an average annual growth rate of 1.7%. Meanwhile, 150,000 new jobs are forecast to be in Portland by 2035 – that is, an average annual growth rate of 1.3% and a return to the pre- 2000 capture rate of 27% of regional jobs.
- $68 million in city business tax revenue (fiscal year 2008-2009)
- 24,300 businesses in the city of Portland – about 30% of the region's 91,000 businesses estimated for 2009

The estimated Census 2008 data lists the City residents' per capita income as $29,672. ($29,700. per capita income estimated 2009). Median earnings for male full-time, year-round workers is $44,612 and $38,522 for females. According to the 2000 Census, Portland had 295,601 people in the workforce with an estimated 2006-2008 total of 310,720 employees, representing a 9.5 percent workforce increase.

Northwest Portland Industrial Area

Current 2006-2008 Census data shows that the City's slow growth trends persist while employment is shifting slightly from the 2000 Census data. Employment has moved away from manufacturing and wholesale and retail trade toward educational, healthcare and social assistance services; arts, entertainment, recreation, accommodation and food services; agriculture, forestry, fishing, hunting and mining; and construction. As referenced in the 2004 NHMP, the City's much diversified economic structure enables small employment fluctuations without causing major economic impacts.

The vulnerability of any city is relative to the diversity of its employment. A diverse economic base and the interdependencies of the economy on outside resources plays into this stability of its economic survival in a disaster. If Portland creates jobs that have localized resources and if these resources in turn are self reliant, there is a better chance of stability after a disaster. But if the economy is dependent on funding streams and resources from outside of the area there could be a greater chance of interrupted service delivery. The green building movement that focuses on localized resources and sustainable practices is a mitigation practice that would allow for expedited recovery. Also the practice of business continuity plan development assures that processes are in place for the prioritization of restoring services that would affect the greatest number of business services being reinstated quicker for the public's welfare.

Table 4-6-5a provides a breakdown of jobs by North American Industry Classification System (NAICS) identification number and the relative number of employees in each employment classification. Manufacturing subtotal is 32,030; Industrial as of 2006 equaled 99,580;Retail equaled 33,120 employed; and service subtotal was 244,730. Within all of the listings the number one employer is Health and Social Assistance with 48,140 employed. Ranking second is Education. These two service area take care of the most vulnerable of populations and are located across the city, within aging buildings (schools) and near a variety of hazardous materials on site (hospitals).

Table 4-6-5a Portland Citywide Employment (2000-2006)

Category	NAICS	Industry	2000	2006
Industrial	11-33	Manufacturing Subtotal	39,780	32,030
	42-49	Industrial Subtotal	118,200	99,580
Retail	44-45	Retail Subtotal	37,070	33,120
Services	51	Information	12,350	10,130
	52	Finance & Insurance	21,390	22,400
	53	Real Estate	9,870	10,330
	54	Prof., Scientific, Tech Services	25,530	25,200
	55	Management	6,820	13,720
	56	Admin Support, Waste	14,020	23,720
	61	Education	29,640	35,540
	62	Health & Social Asst.	40,960	48,140
	71	Arts, Enter., Recreation	6,200	6,230
	72	Accommodation & Food	30,410	33,480
	81	Other Services	17,110	15,840
		Service Subtotal (51,81)	214,380	244,730
Public Other	92	Public Administration	17,110	16,720
	93	Unclassified	2,760	90
		Total	**389,520**	**394,240**

Recent data estimates that about 49% of Portland's jobs are held by Portland residents. Covered employment data indicates 394,000 jobs in the City in 2006.

The City of Portland is a major throughway for oil, gas and electric pipelines and transmission lines connecting Oregon to California and Canada. Portland's energy cluster is located at the confluence of the Willamette and Columbia rivers in highly unstable conditions and is near high density residential and industrial business areas. The vulnerability of this area and the residual impact to Oregon and to our neighboring states is an important industrial interdependency issue which must be considered in all phases of emergency management. The wholesale and transportation dependent businesses of this area with access to rail, road and river and the jobs that depend on the services and goods that come out of this area is noteworthy for inclusion as a separate topic within each natural hazard mitigation chapter in future years.

4.6.6 Transportation and Commuting

Portland is known for its multi-modal transportation system. This includes state, county and City owned, managed and maintained freeways, highways, boulevards, roads, streets and neighborhood routes, bus service, light rail, walking and multiple bicycle routes. Portland's transportation network serves both residential and commercial commuters. The Tri-County Metropolitan Transportation District of Oregon (TriMet) provides public transportation in Portland. TriMet's service includes 79 bus routes and 52 miles of light rail line (Metropolitan Area Express, or MAX). The four MAX lines connect the Portland, Gresham, Beaverton Hillsboro and Clackamas Town Centers. Together, the MAX lines carry about 80,000 riders each weekday. Additionally, Portland has a streetcar system that carries approximately 4,000 passengers per day in the downtown area and Northwest Portland. Portland also has a tram which carries employees, students and patients of Oregon Health Sciences University (OHSU) between the OHSU south waterfront campus and the Marquam Hill campus, Veterans Hospital, Doernbecker and Shriners Childrens hospitals. Traffic on the steep and narrow access route to these hospitals has been reduced because of the tram.

Many of Portland's residents take advantage of public transit for their daily commutes. Commuters and their routes are important considerations for hazard planners. Transit routes keep the economy functioning and provide important lifelines for emergency response. If a disaster were to occur during rush hour, commuters could be seriously impacted. The largest proportion of commuters leaves home between 7:30 and 8:00 a.m. and requires between 15 and 19 minutes to arrive at work. The majority of them drive alone; the next largest percentage takes the bus. Table 4-6-6a.displays the modes of transportation that commuters use in Portland.

Table 4-6-6a Commuter Transportation Modes

Commute Mode	Percent	
	2008	2009
Drove Alone	62%	68%
Rode transit	12%	10%
Carpooled	10%	7%
Walked	5%	5%
Bicycle	6%	7%
Worked at home	6%	NA

Goods travel in and out of Portland through a variety of routes. Waterborne commerce is an important driver in the regional economy. The Port of Portland owns and manages five marine terminals. In the calendar year 2006, the Portland Harbor handled over 24 million tons of cargo for exporters and importers located in the Portland metropolitan area, the state of Oregon and the United States. The Portland Harbor consists of private and Port of Portland marine terminals. Passenger and cargo rail lines traverse the City. Fourteen million passengers used the airlines supported by the Port of Portland air terminal in 2006.

A major north-south interstate freeway, Interstate 5, cuts through the city. Interstate 205 provides an alternate route around the eastern edge of the city and Interstate 405 provides access to downtown Portland. Heavy rail traverses Portland through industrial areas of N, NW and SE with approximately 41.4 miles of track. It follows a line through downtown Portland from NW industrial area into the inner east side high density area. The rail is a major transporter of goods from Portland east through the Columbia Gorge. This rail system also transports the passenger train of AMTRAK.

4.6.7 Community Development Trends

2010 Natural Hazard Mitigation Plan as it relates to the Portland Plan

The Portland Bureau of Planning and Sustainability is currently updating the multi-year Portland Plan. This plan will provide background reports to inform the update of 1980 Comprehensive Plan which is the guide for long range development of the City. The State of Oregon mandates that the plan is updated to meet Periodic Review requirements by 2012. With a 25 year horizon, the plan sets goals for Portland's development and growth management through policies, investments and initiatives. Whereas the Portland Plan is the strategic plan for the City, the Comprehensive Plan is the policy document that implements the strategy.

The current review includes reports on the status of nine action areas, public involvement in the development of priorities and needs and inclusion of land use issues and development trends and projections. Many of the same categories reviewed in the Hazard Vulnerability Analysis and the 2010 Natural Hazard Mitigation Plan strategy are shared in the Portland Plan. The relevance of these two plans being developed concurrently and interwoven is integral to developing a disaster resilient City and for the emergency management discipline to become a part of long range planning of the city.

The nine action areas of the Portland Plan intersect with many of the actions outlined in the 2010 NHMP.

- Prosperity, Business Success and Equity which addresses the economy, unemployment and business districts – business success depends on being able to mitigate losses and to be prepared for the unexpected. 41% of Portland households live within ½ mile of a neighborhood business district. Neighborhood businesses offer services within walking distance which allows for greater accessibility of resources. Accessibility is key to resiliency and mitigating loss to business

- Education and Skill Development which addresses graduation rate, adult education and aging schools. 80% of Portland school buildings were built before 1960. Only six out of 137 schools have been built since 1980 when building codes included seismic strengthening practices. Life and safety is an overarching principle in any long range plan. A livable, sustainable, disaster resilient city has schools that are built to current codes.
- Sustainability and the Natural Environment addresses natural areas, watersheds, water and air quality, tree canopy and energy use. Portland has 26,825 acres of environmentally sensitive natural areas – about 31% of the land area of Portland; 26% of the city is covered by the tree canopy and 69% of Portland's electricity comes from fossil fuels. Plans addressing climate change, watershed management, invasive plants, erosion control, environmental protection are also a part of the Mitigation Plan strategy. Protecting the watershed and the wildlife within it is also a flood protection project. Wildland fire fuel reduction planning is all about protecting the city's canopy of trees and therefore air quality. The lower our use of energy, the lower the need and the lower the loss if service is interrupted.
- The action area of Human Health, Food and Public Safety at first started by addressing life expectancy, obesity, access to parks and healthy food, sense of safety and crime rate. But through the development of the Portland Plan back ground documents and the involvement of citizens in the process, hazard mitigation has been added. Human health and safety is protected when actions are taken to reduce impact of hazards and when hazard mitigation is included as a part of any program's risk assessment. Also healthy people usually can take care of themselves and be survivors that are care givers not victims.
- Neighborhoods and Housing -62% of housing units in Portland are single family homes; 61% of the housing built between 2004 and 2008 were apartments or condos. More density means more people impacted by a disaster, more people depending upon public safety services and more reason for hazards to be included in the criteria of property development
- The Infrastructure background report is a part of the Transportation, Technology and Access action area and concentrates on condition and capacity. Statistics included in this report are that within the City limits there are 3,949 lane miles of roads, 157 bridges, 1,443 miles of separated storm and sanitary sewers, 878 miles of combined sewers, 100 sewer pumping stations, two wastewater treatment plants, the Bull Run Watershed, 33 wells, two dams, 2,200 miles of water pipe, 15,000 fire hydrants, 70 water tanks. These are the resources of the City that allow it to function and are the critical infrastructure that needs to be evaluated for its hazard resiliency. The basic needs of a community are supplied by, through and on the infrastructure.
- Design, Planning and Public Spaces – 180 developed parks, 13 pools, 12 community centers, 177 miles of trails, 300 sports fields, 31 community gardens. The concept of a 20 minute walkable neighborhood which would provide services and access to transportation at its center is an attractive solution to the impacts of growth for Portland. It is also an attractive addition to hazard mitigation because of the strong need for service connectivity and community post disaster. Mitigation actions become a part of community planning through advocating for multiple use facilities, multi-

modal transportation capability and developing a known center of a community. Through design, a community can be created with the form that would allow it to be self reliant, sustainable and low impact of hazard through the correct building practices.

- The two final action areas are only related to Hazards Analysis because Arts and Culture & Quality of Life and Civic Engagement are the reasons why hazard mitigation is important and how – through civic engagement – hazards will be mitigated.

The Portland Plan Background report on Infrastructure Condition and Capability begins with "Imagine Portland with no drinking water, no sewer, no streetlights, no roads, no parks…" And the statement "Taking Care of What We Have" headlines one of its sections. These two statements speak volumes of the development trend. The City's infrastructure is currently in poor condition or will be in the next ten years. The cost to replace aging assets could be $136 million per year for over the next ten years. Infrastructure Bureaus are planning to accommodate the population increase and the system demand within the current foot print of the City. The multi-modal transportation system will extend the life and maintenance of the highway and road system but initial investment into transit alternatives are needed to secure adequate transportation routes. The Portland Water Bureau's primary distribution system can reliably deliver water through 2030 using existing facilities. Demand is expected to increase from 61.5 million gallons per day in 2005 to 79 million gallons per day in 2030. The existing sewer and storm water infrastructure can accommodate projected population growth.

"To maintain Portland's quality of life while accommodating growth, it will be necessary to preserve access to high-quality park and recreation experiences by acquiring and protecting park lands, maintaining existing facilities and providing additional recreational facilities and services. The actual number of parks and facilities that will be needed will vary based on where and how the growth occurs…"

Land use and development trends in the Portland Plan Infrastructure Condition and Capacity background report are found through the recommendations. "1) Set appropriate service levels – The City must decide what services it will deliver. It may be necessary to adjust service standards to match community goals. 2) Develop geographically sensitive approaches. Topographic and environmental constraints vary throughout the city, as do community needs and goals. 3) Identify strategic investments. The City should identify major public infrastructure needed in the next 20 years to address aging assets, regulatory requirements, deficiencies and new growth needs. A coordinated investment strategy should also consider the City's financial limits and factors such as risk, environmental and economic impacts and healthy equity outcomes. 4) Pursue innovative funding sources. The City should pursue new or expanded funding sources, partnerships and work with the community to make tough priority choices. "Development trends in the City will likely slowly but steadily increase staying even with its population growth rate. However, development faces challenges to meet the need for growth while maximizing limited growth opportunities.

Summary

Actions of the Natural Hazard Mitigation Plan must be related to the reduction of vulnerability and risk. The City cannot eliminate the hazards but it can work to educate and elevate the awareness of what individuals, businesses and organizations can do to protect their lives and livelihood through proactive planning. The vulnerability analysis is an estimation of the impact that needs further study and that will provide planners with benchmarks, questions and partnerships to gauge the resolve of hazards impact on the Portland community.

Section 5 Mitigation Strategy

5.1 NATURAL HAZARD MITIGATION VISION AND MISSION

DMA 2000 Requirements: Mitigation Strategy - Identification and Analysis of Mitigation Actions

> **Requirement §201.6(c)(3)(ii):** [The mitigation strategy shall include 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.

DMA 2000 Requirements: Mitigation Strategy - Identification and Analysis of Mitigation Actions: National Flood Insurance Program (NFIP) Compliance

> **Requirement §201.6(c)(3)(ii):** [The mitigation strategy] must also address the jurisdiction's participation in the National Flood Insurance Program (NFIP) and continued compliance with NFIP requirements, as appropriate.

Vision

The 2010 City of Portland NHMP is the same as the 2004 NHMP vision to strive to create a "Disaster Resilient City:"

> *By creating a legacy of mitigation activities, City and community leaders' proactive implementation of long term, cost effective mitigation measures has protected its population, its properties, its natural and built environment and its investments. The forethought of Portland's leaders has preserved the City through decades of hazard events. (Portland 2004)*

Mission Statement

The mission of the 2010 Natural Hazards Mitigation Plan is:

> *To reduce risk, prevent loss of property and commerce and promote expedient recovery, while safeguarding people and the environment from natural disaster events through a coordinated and collaborative community partnership.*

5.2 DEVELOPING MITIGATION GOALS

DMA 2000 Requirements: Mitigation Strategy – Local Hazard Mitigation Goals

> **Requirement §201.6(c)(3)(i):** [The hazard mitigation strategy shall include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.

Mitigation goals are defined as general guidelines that describe what a community wants to achieve in terms of hazard and loss prevention. Goal statements are typically long-range, policy-oriented statements representing community-wide visions.

For the 2004 NHMP, the Planning Team used the exposure analysis results as a basis for developing the mitigation goals and actions. The City selected the five goals in 2004 to reduce or avoid long-term vulnerabilities to the identified hazards for the five-year planning period.

- Identify risk level and evaluate Portland's vulnerability to natural hazards
- Implement activities to protect human life, property and natural systems
- Promote public awareness, engage public participation and enhance partnerships through education, outreach and coordination of a diverse and representative group of the City's population
- Establish a disaster resilient economy
- Build and support the capacity and commitment to continuously become less vulnerable to hazards

For this NHMP update, the Planning Team evaluated the 2004 NHMP's goals and determined they needed to modify them to better meet the city changing needs. The City determined the seven goals to more clearly focus their long-term efforts to reducing risk and vulnerabilities to the identified hazards.

- Update the Risk Assessment and Vulnerability Analysis every five years
- Implement actions to prepare, protect, preserve and restore life, property and natural systems
- Promote public outreach to a variety of City populations
- Improve City of Portland's economic resilience through inclusion of the private sector into mitigation action implementation
- Commit to continuously reducing the City's natural hazards vulnerability
- Maximize mitigation effectiveness by taking a comprehensive approach to natural resource management via city plans, codes and programs that increase mitigation efforts
- Coordinate mitigation activities with regional communities and agencies

5.3 THE CITY'S MITIGATION SUCCESSES

City bureaus have realized that their mission specific programs include mitigation actions. Mitigation fits the Portland goals of becoming sustainable and livable. The understanding of mitigation as a part of planning supports FEMA's intent for developing local jurisdictional mitigation plans as stated in the September 2009 HMA Guidance, "FEMA HMA programs present a critical opportunity to reduce the risk to individuals and property from natural hazards while simultaneously reducing reliance on Federal disaster funds (FEMA 2008)."

Mitigation successes during the 2004-2009 NHMP planning cycle prevent damages and losses from disaster events. They also implement actions of the Wildland Urban Interface Fuel Reduction project, the Watershed Management Plan and upgrade of public safety services. Successes are benchmarks toward the goal of building a more resilient city. The list of successes include those actions that have been completed and also those that are still ongoing but have completed the action listed in the Portland 2004 NHMP.

Table 5-3a NHMP Mitigation Successes

Agency	Mitigation Action	Performance Description (Damages Prevented)
Bureau of Environmental Services (BES)	LTMH#4	Develop Citywide vegetation and protection strategy to protect wildfire, flood and landslide hazards
BES	STLS#2	Improve property owner awareness of property maintenance of private drainage systems
BES	LTLS#5	Update BES Sewer Systems and Drainage Facilities Design Manual
Government Relations	STEQ#5	Lobby to implement Obligation Bonds to fund rehabilitation of critical infrastructure and schools.
City Forester, Parks	STSW#3	Manage planting and maintenance of trees in the public right of way to minimize risk due to fire and landslide
BES	LTEQ#9	Assess stability of levees
PBOT	STMH#2	Form a committee to identify and coordinate critical transportation (street and highway) networks to enable emergency response prioritized route clearance and alternate routing during congestion or road blockages
POEM/Water	LTMH#11	Support development of a multiple-agency plan for Marine Drive closure coordination
BPS	LTLS#2	Acquire, demolish or relocate structures from hazard prone areas
POEM	LTMH#10	Assess the stability of levees in the Columbia Corridor Area and develop appropriate emergency plans
BES	LTEQ#2	Conduct a vulnerability analysis of Portland's sewer system to identify potential for collapse
BDS	STFL#2	Continue to co-fund improvements to river and stream gauges in the Portland metro area with USGS
BES	STFL#5	Acquire outside funding to hire a consultant to lead the application process for a continued Class 5 rating for CRS

Table 5-3a NHMP Mitigation Successes

Agency	Mitigation Action	Performance Description (Damages Prevented)
BES	STFL#9	Secure funding to implement the passive flood management projects
BDS	STFL#10	Improve definitions and refine standards for storm water retention
BES/Parks/BPS	LTFL#1	Increase funding for the Johnson Creek Willing Sellers Program
BDS/BES/PBOT	ST-LS#1	Continue to maintain and improve internal city communications to facilitate coordination
BES/PBOT	STLS#4	Initiate more operations and maintenance pilot projects along roads that inform about development
BDS	LTLS#1	Develop a comprehensive landslide map for the City to identify historic hazard areas
BES, BPS	LTLS#3	Evaluate the role of drainage systems in the West Hills
BES	LTLS#6	Employ alternative construction methods to reduce the impact of development on landslide prone areas
Fire/Parks	LTWF#4	Complete an assessment to characterize high priority wildfire risk areas and recommend strategies

Blackberries fuel preemptive burn to mitigate wildland urban interface fire

5.4 IMPLEMENTED STAFFORD ACT 406 MITIGATION ACTIONS

Successful mitigation strategy:
purchase of tire chains for transit buses

The 2010 Natural Hazard Mitigation Plan focuses on pre-disaster mitigation projects. Pre DMA 2000, mitigation plans were primarily created post disaster with the intention of preventing greater loss. The City o Portland did this after the floods of 1996. After the winter storms of 2008 Oregon Emergency Management (OEM) surveyed Public Assistance (PA) Program project worksheets (PWs) for funded Stafford Act §406 hazard mitigation projects (projects) to determine the efficacy of their PA-enhanced Stafford Act §406 mitigation program, which supplements damage repairs to reduce future damages.

OEM examined relevant project information from the two federally declared disasters that occurred during the last planning cycle, DR-1824 (Severe Winter Storm of December 13-26, 2008) and DR-1510 (Severe Winter Storm of December 26, 2003 through January 14, 2004).

OEM identified 13 sites where Section 406 funds enabled additional mitigation beyond damage repair. Mitigations performed successfully at 12 of the 13 sites from 2004 through the latest severe winter storm (DR-1824). The remaining site (City of Portland PW 277) received two different mitigation actions. One of these succeeded the other did not. There were five successful mitigations types:

- Electrical; monitored alarms, surge/phase protection, transfer switch – five projects
- Roof attachments; snow guards, gutter attachments – three projects
- Roof structural; truss upgrades – two projects
- Plumbing; insulation, heat tapes – two projects
- Tire chains; upgrade – one project

The unsuccessful mitigation activity involved installing snow guards above the ductwork to prevent roof snow and ice slide damage. The snow guards proved insufficient to handle the snow loads at the site due to above average snow loads. Heavy snow loads damaged the ductwork several times over a three to four year period. In 2008, the applicant installed a very heavy-duty metal framework around the ductwork. This proved successful during the 2008 severe winter storm (DR-1824 event).

The City received Stafford Act §406 funding for four of the listed damage sites. Table 5-4a lists the City's §406 Mitigation success stories by Disaster number.

Table 5-4a City of Portland's §406 Mitigation Success Stories by Disaster Number

Applicant	Damage Narrative	PW Project Repair Cost	Mitigation Action	406 Mitigation Implementation Cost	Success Story by Disaster Number
City of Portland DR-1510 PW#277	Heavy snow and ice slid off roof and damaged HVAC unit and ductwork	$8,515.00	Mitigation raised HVAC unit and placed snow/ice shields on roof	$2,305.00	Applicant reports that mitigation worked well through latest storm (DR-1824) for HVAC unit in latest storm, DR-1824.
	Heavy snow and ice slid off roof and damaged ductwork		Mitigation Placed snow/ice shields on roof		Applicant reports that mitigation did not work for ductwork. Ductwork damaged in 2005 (1510) and again in 2007-2008. Applicant attempted mitigation in 2005 (unsuccessful) and again in 2008 which successfully protected ductwork in latest storm, DR-1824.
City of Portland East Portland CC DR-1510 PW#280	Power outage resulted in frozen/burst pipes in boiler room	$3,350.46	Mitigation added a monitored temperature sensor to boiler room	$318.00	Applicant reports that mitigation worked well through latest storm, DR-1824.
City of Portland Pittock Tea House DR-1510 PW#283	Freezing temperatures caused pipes and radiators to burst	$35,846.28	Mitigation added a monitored temperature alarm in furnace room	$277.50	Applicant reports that mitigation worked well through latest storm, DR-1824.
TRIMET DR-1510 PW#116	Heavy snow and ice conditions resulted in broken bus tire chains and damage to vehicles	$137,000.00	Mitigation replaced broken chains with stronger chains constructed using nickel/ manganese steel alloy with a case hardened core	$18,840.00	Applicant reports that mitigation worked well through latest storm, DR-1824.

The eligible PA infrastructure damages were $289,000. Total mitigation cost of the 13 projects was approximately $74,000. This equates to applying approximately 25 percent to the total eligible project costs creating a vast savings over subsequent disaster events.

The following photos depict the temperature sensors added as 406 mitigation initiatives to supplement hazard-generated, PA-funded repairs.

Figure 5-4a Boiler Room Temperature Sensor at East Portland Community Center

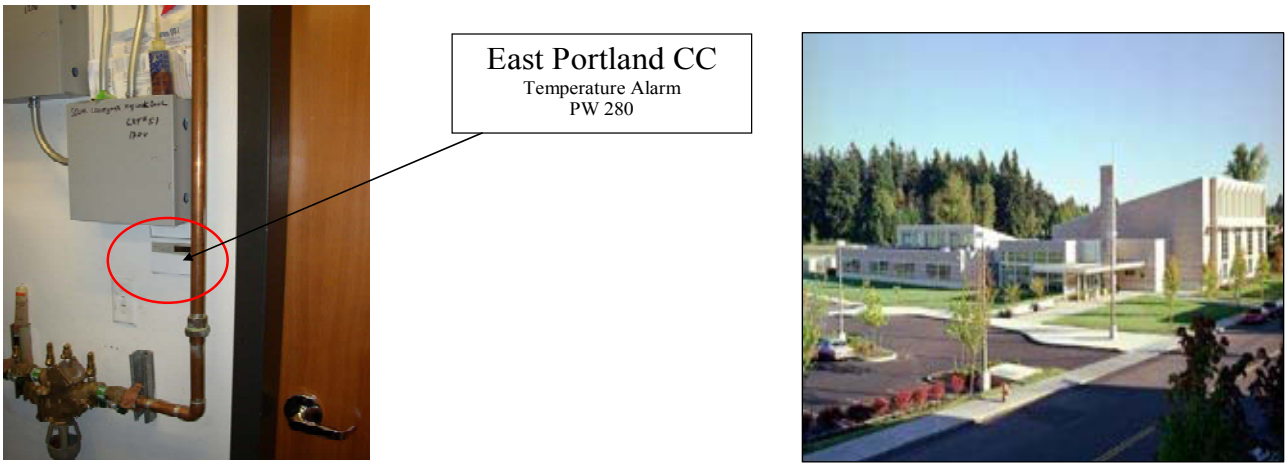
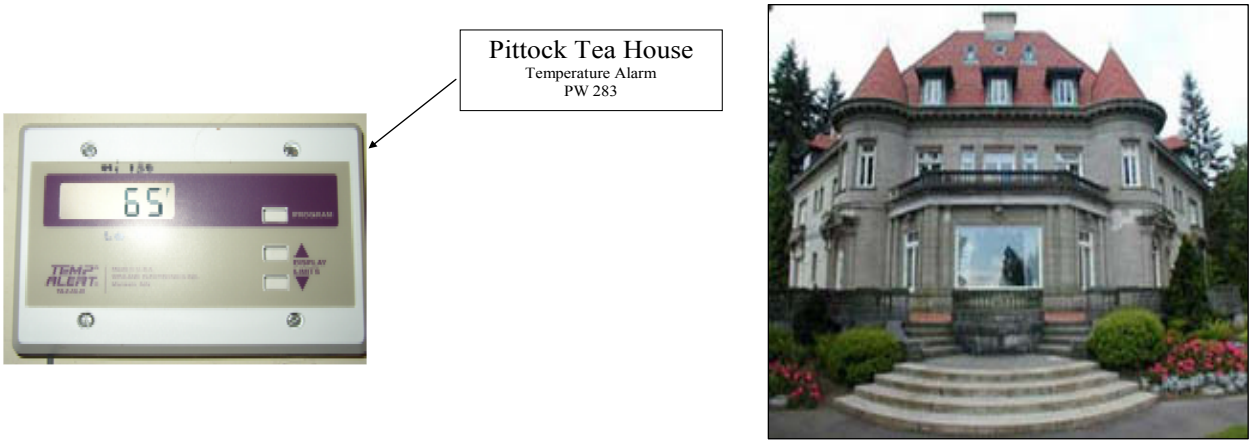


Figure 5-4b Furnace Room Temperature Sensor at Portland Parks Bureau Pittock Mansion Tea House



The Pittock Mansion is a French Renaissance château in the West Hills of Portland, Oregon originally built as a private home for *The Oregonian* publisher Henry Pittock and his wife, Georgiana. It is a 22 room estate built of Tenino Sandstone situated on 46 acres that is now owned by the city's Bureau of Parks and Recreation.

5.5 EVALUATING AND PRIORITIZING MITIGATION ACTIONS

DMA 2000 Requirements: Mitigation Strategy - Implementation of Mitigation Actions

> **Requirement: §201.6(c)(3)(iii):** [The mitigation strategy section shall include] an action plan describing how the actions identified in section (c)(3)(ii) 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.

The Mitigation Action Plan represents mitigation projects and programs the City will implement through the cooperation of multiple entities. The Planning Team was tasked with reviewing previous NHMP mitigation actions to determine their current status and potential cost benefit ratio. Four POEM interns from Portland State University conducted research, gathered data and provided summary statements as to streamline the process. POEM facilitated a Planning Team Meeting to determine any existing data gaps, solicited subject-matter experts' assistance to close those gaps and consolidated the resultant information.

The Planning Team reviewed the simplified STAPLEE evaluation criteria and decided not to use the STAPLEE method due to time constraints and process complexity. The Team determined they comprised the expertise and historical knowledge to select and prioritize the City's mitigation activities. The Planning Team reviewed the existing goals and proceeded to edit them to better reflect the City's growing needs.

Mitigation project to stabilize Portland's water system, 2008

On November 6, 2009, the Planning Team prioritized each of the 114 selected mitigation actions for implementation. Table 5-6-1a contains those actions brought forward for implementation during the new five-year planning cycle. The selected mitigation actions each contain a qualitative benefits/costs and technical feasibility narrative statement. It is understood that the list of actions is for planning and record keeping purposes. A detailed benefit/cost analysis is required as part of the application process for those projects the City chooses to implement.

5.6 MITIGATION ACTION PLAN IMPLEMENTATION

The mitigation action plan identifies short and long-term action items developed through data collection and research. Mitigation plan activities may be considered for funding through State and Federal grant programs, including FEMA's Hazard Mitigation Grant Program, Pre-Disaster Mitigation Grant Program and Flood Mitigation Assistance (FMA).

5.6.1 Mitigation Plan Action Items

Action items address Multi-Hazard(MH), hazard specific issues and floodplain actions to ensure continued NFIP compliance for the hazards addressed in this plan. To facilitate implementation, each action item includes information on timeline, coordinating and partner organizations and NHMP goals.

Priority

The Planning Team then reviewed the comprehensive list of existing mitigation actions' status to determine if they meet the newly revised goals. They then cooperatively reviewed the Benefit-Cost Analysis Fact Sheet (Appendix E) to consider the opportunities and constraints of implementing selected mitigation actions.

The Team used this as a starting point to prioritize those actions under their purview as they pertain to each bureau's ability to accomplish those actions; and then used the following process to prioritize their mitigation actions:

- Analyzed each action item by hazard to determine how many of the goals applied to each action item.
- Analyzed the number of hazards that each action item addressed.
- Each bureau charged with implementation responsibility then determined those action items' priority. They then considered whether the action item was on their existing work plan, have available or identified funding and determined whether it is ready to implement.
- Each hazard's history, extent and recurrence probability was analyzed and each mitigation action ranked in descending order with the action item demonstrating the highest mitigation potential at the top of the list with the remaining action items followed in descending order: Each action item was assigned a priority ranking of high, medium, or low:
- *High* priorities are associated with actions for hazards that impact the community on an annual or near annual basis and generate impacts to critical facilities and/or people.
- *Medium* priorities are associated with actions for hazards that impact the community less frequently and do not typically generate impacts to critical facilities and/or people.
- *Low* priorities are associated with actions for hazards that rarely impact the community and have rarely generated documented impacts to critical facilities and/or people.

Coordinating Organization

The coordinating organization is the public agency with regulatory responsibility to address natural hazards, or that is willing and able to organize resources, find appropriate funding, or oversee activity implementation, monitoring and evaluation. The coordinating organization for all action items for the NHMP is the City and more specifically a bureau from the City.

Internal Partners

Internal partner organizations are bureaus within the City that may be able to assist in the implementation of action items by providing relevant resources to the coordinating organization.

External Partners

External partner organizations can assist the City in implementing the action items in various functions and may include local, regional, State, or Federal agencies, as well as local and regional public and private sector organizations. Reference to any partner, either internal or external does not mandate their inclusion in the implementation process but is to be used as a suggestion of agencies that may participate.

Timeline

Action items include both short- and long-term activities. Each action item includes an estimate of the timeline for implementation.

Short-term action items are activities that City departments may implement with existing resources and authorities within one to two years.

Long-term action items may require new or additional resources and/or authorities and may take between one and five years (or longer) to implement.

Plan Goals Addressed

The NHMP goals addressed by each action item are identified as a means for monitoring and evaluating how well the mitigation plan is achieving its goals following implementation.

Appendix C (Table C-4a) contains the matrix that was a part of the planning process. It lists all of the action items from 2004, deleted, deferred, ongoing and completed actions.

Potential Funding Sources

The following is a list of the potential funding sources identified in Table 5-6-1a:

- FEMA HMA
- FEMA Assistance to Firefighters Grant (AFG) Programs
- Fire Prevention and Safety Grant (FP&S) Program
- Staffing for Adequate Fire and Emergency Response (SAFER) Program
- Emergency Food and Shelter Program (EFSP)
- Lindbergh Grant Program (LGP)
- National Resource Conservation Service (NRCS)
- Public Private Partnerships

Benefit/Cost and Technical Feasibility

Table 5-6-1a contains a short narrative statement regarding each project's Benefit versus Cost (B/C) analysis. The table also contains a short narrative statement about each project's technical feasibility (TF). The City will perform detailed benefit/cost analysis as a part of grant application preparation phase to fulfill FEMA grant criteria and requirements.
FEMA's BCA website states: (http://www.fema.gov/government/grant/bca.shtm)

"Applicants and Sub-Applicants must use FEMA-approved methodologies and software to demonstrate the cost-effectiveness of their projects. This will ensure that the calculations and methods are standardized, facilitating the project evaluation process.

FEMA has developed a suite of Benefit-Cost Analysis (BCA) software for a range of major natural hazards: earthquake, fire (wildland/urban interface fires), flood (riverine, coastal A-Zone, Coastal V-Zone), Hurricane Wind (and Typhoon) and Tornado. Sometimes, however, there is not enough technical data available to use the BCA software.

When this happens, or for other common, smaller-scale hazards or more localized hazards, BCAs can be done with the Frequency Damage Method (i.e., the Riverine Limited Data module), which is applicable to any natural hazard as long as a relationship can be established between how often natural hazard events occur and how much damage and losses occur as a result of the event. This approach can be used for windstorms, freezing, mud/landslides, severe ice storms snow and volcano hazards.

Alternative BCA software may also be used, but only if the FEMA Regional Office and FEMA Headquarters approve the software."

A prioritized list of action items, their potential funding source and technical feasibility has been collected in the following table. Columns identify the actions according to Action ID number, Description (which includes a theme for coordinated planning purposes – education & outreach, planning, NFIP, mapping and asset management) the responsible department and the potential

funding/feasibility. Action items will be analyzed for cross bureau collaboration and their applicability to multiple agency plans. Prioritization is to identify which actions address multiple hazards, goals and feasibility because they will have a higher potential for implementation.

Smoke on the water exercise collaboration, 2010

Table 5-6-1a Benefit Vs. Cost Analysis

Action ID	Goals	Description	Prioritization (High, Medium, Low)	Responsible & Coordinating Bureaus & Agencies	Potential Funding AGENCIES	Timeframe	(B/C) Benefit-Costs (TF) Technical Feasibility
ST MH #1	1-7	Continue to involve the public in updating the Natural Hazard Mitigation Plan. (education & outreach)	High	POEM, BPS, ONI	City of Portland	**ST Ongoing**	B/C: Continued public involvement is critical to activity success and builds initiative support. TF: This is a non-technical activity involving effective communication, staff resources and outreach; this activity is feasible for the City to complete.
ST MH #2	2,3,4,6,7	Form a committee to identify and coordinate critical transportation (street and highway) networks. (mapping, asset management)	Medium	PBOT, POEM,BPS	City of Portland	**ST Ongoing**	B/C: Agreements of identified infrastructure to be strengthened to withstand area hazards and post disaster procedures that can immediately be implemented to expedite service delivery reduces costs of disaster. TF: This is feasible using existing resources as the City has awareness of existing and future transportation requirements.
ST MH #3	2-7	Coordinate emergency standard operating procedures and plans between disaster responder organizations in the Portland metro region, to coordinate and expedite decision-making during emergencies. (planning)	High	POEM, PBOT, BF&R, BOEC	City of Portland, DHS	**LT Ongoing**	B/C: Coordinated multi-bureau planning and the understood system interdependencies ensure prioritized restoration of systems and coordinated response to affect the greatest number of people in the least amount of time therefore reducing the loss of life, property and affect on the economy. TF: This is feasible to accomplish as no cost is associated with the action and planning is already active between multiple bureaus and agencies.
ST MH #4	2,3,6,7	Develop a multiple-agency multi-hazard evacuation plan (EQ, flood, fire and landslide at a minimum).	High	POEM, PBOT	City of Portland, FEMA AFG, FP&S, SAFER, EFSP, DHS	**LT Ongoing**	B/C: Pre-established plans for transportation system vulnerabilities, alternate routing in potential hazard areas and the responsible agencies to implement routing of populations away from hazards increases the number of lives taken out of harms way and decreases injury and loss of life. TF: This activity involves effective communication and staff resources, is feasi-ble for the City to complete because planning is currently being implemented.
ST MH #5	1-7	Acquire Light Detection and Ranging (LiDAR) images of the Portland Metro area to facilitate natural hazard area risk assessment and vulnerability analysis. (mapping) **(NFIP Compliance)**	High	POEM, CGIS, BES, BF&R, Water, PBOT	City of Portland, FEMA HMA, FEMA AFG, FP&S, SAFER, DHS	**ST Ongoing**	B/C: Pre-identification of hazard areas ensures that structures are not placed within hazard areas. Developing a mapping committee ensures a comprehensive approach to determining the City's mapping needs. TF: This is feasible as financial resources become available. LiDAR will greatly enhance the City's risk and vulnerability analysis through expanded mapping capability.
ST MH #6	1,4,7	Use findings from Portland's Risk Assessment (HAZUS-MH) to enhance existing debris removal plan. HAZUS-MH will need to be updated. (existing GIS Mapping)	Low	BPS, POEM, PBOT, BES	City of Portland, FEMA HMA	**ST Ongoing**	B/C: Pre-identification of appropriate land for potential the different types of waste will expedite recovery and decrease the potential of public health issues related to debris. TF: This is feasible as financial resources become available. HAZUS MH data will greatly enhance the City's debris management analysis through expanded mapping capability.
ST MH #7	1,2,6	Create a mitigation mapping committee to index and maintain GIS mapped inventory and develop prioritized list of critical facilities, residential and commercial buildings within known hazard areas such as earthquake, erosion, the 100-year and 500-year floodplains, invasive plant species, landslide and wildfire areas. (NFIP Compliance) Identify parameters and methods for new maps as needed to meet multi-hazard mitigation goals and to improve communication with the public.	High	POEM, CGIS, BES, PBOT, BDS. BF&R, Water, BPS	City of Portland	**ST Ongoing**	B/C: Coordinated mapping ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. It also ensures bureau coordination which expedites understanding as it applies to asset management as related to hazards. TF: This is feasible using existing resources. The City's possesses GIS infrastructure to easily accomplish these tasks.

Table 5-6-1a Benefit Vs. Cost Analysis

Action ID	Goals	Description	Prioritization (High, Medium, Low)	Responsible & Coordinating Bureaus & Agencies	Potential Funding AGENCIES	Timeframe	(B/C) Benefit-Costs (TF) Technical Feasibility
ST MH #8	3,4,5,6,7	Partner with utilities as they ensure continuity of service to the City and the Columbia South Shore Well field to provide for redundancy in case of primary power outage. (asset management)	High	Water, BES	City of Portland, Utility Companies	**ST Ongoing**	B/C: Redundant capability is essential for sustainability and operations continuity. TF: This activity is technically feasible within the community through partnership agreements or memoranda to maximize existing utility infrastructure availability.
ST MH #9	3,5,6	Develop a city employee emergency response plan to assure that city employees know what is expected of them to continue City operations. (education, outreach)	High	POEM, HR, OMF, BGS, BF&R, Police, BOEC	City of Portland, DHS	**ST Ongoing**	B/C: City employees who are trained can aid the public in disaster if they are at home or at work multiplying the ability for the community to be self reliant and therefore reducing potential injury and loss of life. Employees trained to respond in a coordinated manner continues the operation of the city so that there is less impact on the public and the economy. TF: This activity involves effective communication and staff resources; this activity is currently in practice and is feasible for the City to complete.
ST MH #10	2,3,5,6	Develop educational materials (television and print media) for residents that identify and define their risk to multi hazards: define and offer mitigation measures that residents can take home or share, determine method of distribution of the educational materials and coordinate with the media to reduce conveyance of misinformation. (education, outreach)	High	POEM	City of Portland FEMA HMA, FEMA AFG, FP&S, SAFER, EFSP, DHS, NRCS	**ST Ongoing**	B/C: Sustained mitigation outreach program has minimal cost and will help build and support area-wide capacity. This type activity enables the public to prepare for, respond to and recover from disasters. TF: This low cost activity can be combined with recurring outreach opportunities at meetings where hazard specific information can be presented in small increments. This activity is ongoing demonstrating its feasibility.
ST MH #11	2,5,6,7	Implement actions in the 2005 Portland watershed management Plan (PWMP) (planning) **(NFIP Compliance)**	High	BES	City of Portland	**ST Ongoing**	B/C: Coordinated planning ensures effective damage abatement and ensures proper attention is assigned to reduce losses and damage to structures and City residents. Watershed management reduces flooding, landslides, the impact of severe weather and erosion. TF: This activity involves effective communication and staff resources; this activity is feasible for the City to complete. This activity is ongoing demonstrating its feasibility.
LT MH #1	2,5,6,7	Revise Portland's Comprehensive Plan to address and implement Citywide policies, land use improvements and mapping changes to natural hazards including, but not limited to, earthquakes, erosion, floods, invasive plants, landslides, volcano, severe weather and wildfires. (mapping, planning) **(NFIP Compliance)**		BPS	City of Portland	**LT Ongoing**	B/C: Land use planning that considers hazards as an integral component, policies can be established that will ensure reduction of loss and damage to structures. TF: This activity is feasible and currently being implemented through the background reports of the Portland Plan which will inform the 25 year long range Comprehensive Plan.
LT MH #3	2,4,7	Increase the responsiveness of the emergency permitting procedures for post-hazard event periods through development of a procedural plan and the purchase of a mobile permitting van. (planning)	Medium	BDS,BOT, BES, Water, Risk Management	City of Portland	**LT Ongoing**	B/C: Rapid emergency permitting processes enables expedited project commencement and service continuity. TF: This project is feasible using existing staff by streamlining the permitting process while ensure essential criteria are fulfilled.

Table 5-6-1a Benefit Vs. Cost Analysis

Action ID	Goals	Description	Prioritization (High, Medium, Low)	Responsible & Coordinating Bureaus & Agencies	Potential Funding AGENCIES	Timeframe	(B/C) Benefit-Costs (TF) Technical Feasibility
LT MH #6	3,4,7	Promote the development of TriMet communications and dispatch capability to immediately implement changes to transit routes and service due to disruption of streets, roads, bridges, rail transit tracks and the information technology that provides connectivity. (planning)	Medium	PBOT, BOEC, POEM	City of Portland, TriMet	**LT Ongoing**	B/C: Technological interconnectivity for communicating with people and services in the field will ensure populations in hazard areas are being alerted to danger so they can effectively respond and avoid or reduce impact of a disaster or emergency. TF: This activity involves effective communication and staff resources; this activity is ongoing demonstrating its feasibility.
LT MH #8	1,2,5,6,7	Review and amend City Code and other compliance documentation to require that all facilities that store or handle hazardous materials (including large tanks) and which are located in the 500-year floodplain, landslide, or other hazard areas, develop a hazardous materials inventory statement. This statement will be made available for Fire Bureau review. Require that these storage tanks are either adequately protected or relocated outside of the 500 year floodplain, landslide, or other hazard areas. (asset management) **(NFIP Compliance)**	High	BF&R, POEM, BDS	City of Portland, DHS	**LT Ongoing**	B/C: Implementing this mitigation activity will potentially reduce ancillary HAZMAT damages from earthquakes, floods, landslides and other potential hazards. TF: This type activity is technically feasible within the community typically using existing labor, equipment and materials.
LT MH #9	2,5	Identify and pursue funding opportunities from outside agencies to fund and implement identified mitigation projects and activities. (education, outreach)	High	All bureaus	City of Portland, FEMA HMA, FEMA AFG, FP&S, SAFER, EFSP, DHS, NRCS, LGP	**New LT**	B/C: Although primarily a funding strategy the development of a plan for funding will aid in the decisions for implementation. This activity is essential for the City as there are limited funds available to accomplish effective mitigation actions. TF: This activity is ongoing demonstrating its feasibility.
LT MH #10	2,5,7	Assess the stability of levees in the Columbia Corridor Area and develop appropriate emergency plans to address potential levee failure and associated hazards. (planning)	High	POEM, Water, BF&R, BES, PBOT	City of Portland	**New LT Ongoing**	B/C: Pre-identification ensures that structures perform appropriately during impacts and are built with the hazard as a focus. TF: This is feasible using existing resources as the community has access to levee project reports and studies.
LT MH #11	2,4,5,6,7	Support development of a multiple-agency plan for Marine Drive closure coordination. (planning)	High	POEM, Water	City of Portland	**New LT Ongoing**	B/C: Coordinated planning ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This activity involves effective communication and staff resources; this activity is feasible for the City to complete. This activity is ongoing demonstrating its feasibility.
LT EQ #11	5,6,7	Work with local jurisdictions to assess the capacity of landfill to accommodate earthquake debris: develop coordination plans for disposal of debris in the aftermath of an earthquake. (planning)	High	POEM, PBOT, BPS	City of Portland, FEMA HMA	**LT Ongoing**	B/C: Coordinated planning ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This activity involves effective communication and staff resources; this activity is feasible for the City to complete. This activity is ongoing demonstrating its feasibility.

Table 5-6-1a Benefit Vs. Cost Analysis

Action ID	Goals	Description	Prioritization (High, Medium, Low)	Responsible & Coordinating Bureaus & Agencies	Potential Funding AGENCIES	Timeframe	(B/C) Benefit-Costs (TF) Technical Feasibility
New MH	2,5,6,7	Cross reference and incorporate mitigation planning provisions into all community planning processes such as comprehensive, capital improvement and land use plans, to demonstrate multiple bureau benefits and strengthen eligibility from multiple funding sources. This action is also identified in LTFL#8, IS#94 & SW#117. (planning)	High	POEM, BPS, BF&R, PBOT, Water, BES	City of Portland	**LT Ongoing**	B/C: By cross referencing many bureau plans that affect actions other than hazard mitigation and identifying the impact of the bureau plan on mitigating disaster the cost of implementation can have an add value benefit. TF: This activity involves effective communication and staff resources; this activity is feasible for the City to complete. This activity is ongoing demonstrating its feasibility.
New MH	1,2,3,5,6	Identify and list repetitively flooded structures and infrastructures, analyze the threat to these facilities and prioritize mitigation actions to protect the threatened population. **(NFIP Compliance)**	High	BPS, PBOT, BES, POEM; State Floodplain Manager	City of Portland, FEMA HMA, NRCS	**New LT Ongoing**	B/C: Flood hazard mitigation is among FEMA's highest national priorities. FEMA desires communities focus on repetitive flood loss properties. This activity will ensure the City Council focuses on priority flood locations and projects. TF: This project is feasible as funding becomes available using effective communication, staff resources and existing facilities. This activity is feasible for the City to complete and is ongoing demonstrating its feasibility.
New Reworded MH	1,2,4,5	Acquire (buy-out), demolish, or relocate structures from hazard prone area. Property deeds shall be restricted for open space uses in perpetuity to keep people from rebuilding in hazard areas. (planning) **(NFIP Compliance)**	High	BPS, PBOT, BES, POEM; State Floodplain Manager, BGS, BP&R, BDS, BES, Risk Management	City of Portland, FEMA HMA, FEMA AFG, FP&S, SAFER, DHS, NRCS,	**New LT Ongoing**	B/C: Flood hazard mitigation is among FEMA's highest national priorities. F This activity will ensure the City Council focuses on priority flood locations and projects to remove threatened structures from the floodplain and other hazard areas, eliminating future damage while keeping land clear for perpetuity. 7TF: This project is feasible as funding becomes available using existing staff skills, equipment and materials.
New MH	2,5,6	Develop and incorporate building ordinances commensurate with building codes to reflect survivability from all hazards to ensure occupant safety. **(NFIP Compliance)**	High	POEM, BDS, BPS	City of Portland	**New LT Ongoing**	B/C: Coordinated planning through building codes and ordinances can reveal how one action by a developer or a construction technique to cost less and provide more protection to the property owner or the community. TF: This activity involves effective communication and staff resources; this activity is ongoing demonstrating its feasibility.
New MH	1,5,6	Update the Infrastructure Master Plan and System Vulnerability Assessment, Sewer Failure Response Plan. (asset management, planning)	High	POEM, BPS, Water, PBOT, BES, OMF, BDS, BP&R, PDC,	City of Portland	**New LT**	B/C: Infrastructure vulnerability location pre-identification ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This activity involves effective communication and staff resources; this activity is feasible for the City to complete. This activity is ongoing demonstrating its feasibility.
NEW MH	5,6,7	Partner with agencies to develop a west side operations center to be used during an emergency if the east side ECC and other City facilities become inoperable.	A.1 High	POEM, BF&R, Police	City of Portland,	**New LT**	B/C: Alternate operations locations away from known hazard areas and accessible to resources are essential for sustainability and operations continuity. TF: This activity is technically feasible within the community using existing facility acquisition processes.
New MH	2,5,6	Promote 09 Climate Action Plan action items with similarities to adaptation planning and mitigation actions. (planning)	A.2 HIGH	POEM, BPS	City of Portland	**New LT**	B/C: Coordinated planning ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This activity involves effective communication and staff resources; this activity is feasible for the City to complete. This activity is ongoing demonstrating its feasibility.

Table 5-6-1a Benefit Vs. Cost Analysis

Action ID	Goals	Description	Prioritization (High, Medium, Low)	Responsible & Coordinating Bureaus & Agencies	Potential Funding AGENCIES	Timeframe	(B/C) Benefit-Costs (TF) Technical Feasibility
ST EQ #2	5,6	Assess existing earthquake related mitigation plans and vulnerability studies to identify areas of conflict, duplication or gaps between studies & secondary hazards of earthquake. (planning)	High	POEM, BF&R, PBOT, BES, Water, BDS, BPS	City of Portland	**ST Ongoing**	B/C: Infrastructure vulnerability location pre-identification ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This activity involves effective communication and staff resources; this activity is feasible for the City to complete. This activity is ongoing demonstrating its feasibility.
ST EQ #3	6	Update the vulnerability analysis of Columbia Boulevard Wastewater Treatment Plant (CBWTP0 Tryon Creek Wastewater Treatment Plant (TCWTP) and wastewater pump stations. (asset management, planning)	High	BES, PBOT	City of Portland	**ST Ongoing**	B/C: Infrastructure vulnerability location pre-identification ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This activity involves effective communication and staff resources; this activity is feasible for the City to complete. This activity is ongoing demonstrating its feasibility.
ST EQ #4	6	Prioritize the return of power to treatment plants (Tryon Creek and Columbia Boulevard) and pump stations.	High	BES, POEM	City of Portland, PGE	**ST Ongoing**	B/C: Redundant capability is essential for sustainability and operations continuity ensuring City water utility sustainability and the population's health and safety. TF: This activity is technically feasible within the community through partnership agreements or memoranda to maximize existing utility infrastructure availability.
ST EQ #8	5	Study the feasibility of mandatory or voluntary installation of seismic shutoff valves on natural gas meters at commercial and residential buildings.	Medium	BF&R, BDS, POEM	City of Portland, FEMA HMA, FEMA AFG, FP&S, SAFER, EFSP, DHS, NRCS,	**ST**	B/C: Coordinated legislation ensures consistency, enforcement and protection to the City's population and resource expenditure reduction. TF: This activity is technically feasible and involves effective communication and staff resources; this activity is feasible for the City to complete.
LT EQ #3	2,6	Develop a plan to strengthen sewer infrastructure in areas where street overlays and sewers have potential to collapse in a seismic event. (asset management)	Medium	PBOT, CGIS; BES, Water, POEM	City of Portland	**LT Ongoing**	B/C: Coordinated planning ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This activity involves effective communication and staff resources; this activity is feasible for the City to complete. This activity is ongoing demonstrating its feasibility.
LT EQ #6	1,5,6	Assess the vulnerability of the water distribution system to seismic events: work toward hardening the system.	Low	Water	City of Portland	**LT Ongoing**	B/C: Infrastructure vulnerability location pre-identification ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This activity involves effective communication and staff resources; this activity is feasible for the City to complete. This activity is ongoing demonstrating its feasibility.
LT EQ #8	5,6	Study development regulations and policies to ascertain if regulations can be made to limit development of high risk facilities in known areas of earthquake hazards.	Low	POEM, BDS, BPS, PBOT, BF&R	City of Portland	**LT Ongoing**	B/C: Coordinated planning ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This activity involves effective communication and staff resources; this activity is feasible for the City to complete. This activity is ongoing demonstrating its feasibility.
SW #2	2,5,6	Acquire an additional facility for storage of anti-icing materials and expand anti-icing vehicle inventory.	Low	PDOT BDS, Facilities, Vehicle Services	City of Portland	**ST Ongoing**	B/C: Strategically pre-located additional facilities ensure that materials and resources are able to quickly respond to emergency situations or conditions. TF: This project is feasible using existing staff skills, equipment and materials when funding is available.

Table 5-6-1a Benefit Vs. Cost Analysis

Action ID	Goals	Description	Prioritization (High, Medium, Low)	Responsible & Coordinating Bureaus & Agencies	Potential Funding AGENCIES	Timeframe	(B/C) Benefit-Costs (TF) Technical Feasibility
ST SW #6	2,3,5	Insulate residential buildings that house at-risk populations.	Low	PDC	City of Portland, FEMA HMA	**ST Ongoing**	B/C: This activity would reduce health and heating costs for high risk populations TF: This project is feasible using existing staff skills, equipment and materials.
ST SW #7	5,6	Prioritize existing building stock for active review of Title 29 (Dangerous Building Code) This needs to be updated with intern information or information sent from individuals that are on the team.	Medium	BDS	City of Portland	**ST Ongoing**	B/C: Pre-identification ensures that structures are appropriately coded and prioritized for removal or rehabilitation – appropriately addressing known or potential hazard impacts. TF: This activity involves effective communication and staff resources; this activity is feasible for the City to complete. This activity is ongoing demonstrating its feasibility.
ST FL #1	2,5	A covenant is recorded with the deed of new development in the floodplain to ensure that space below the BFE is not converted to habitable space. This should be codified to improve compliance. **(NFIP Compliance)**	High	BDS	City of Portland	**ST Ongoing**	B/C: Coordinated planning ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This activity involves effective communication and staff resources; this activity is feasible for the City to complete. This activity is ongoing demonstrating its feasibility.
ST FL #2	2,4,5,6	Continue to co-fund improvements to river and stream gauges in the Portland metropolitan area with the United Geological Survey.	Low	BDS	City of Portland, NOAA/NWS	**ST Ongoing**	B/C: This ongoing activity is essential for the City as there are limited funds available to accomplish effective mitigation actions. This joint effort strengthens County and City warning capabilities. TF: Fund acquisition is a continuous ongoing activity demonstrating its feasibility.
ST FL #4	5,6,7	Secure the agreements necessary to design and implement the redevelopment of Freeway Land Company site. (within the Lents Urban Renewal Area)	High	BES, PDC; BPS, PBOT, BP&R	City of Portland	**ST Ongoing**	B/C: Coordinated planning effort ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This activity involves effective communication and staff resources; this activity is feasible for the City to complete. This activity is ongoing demonstrating its feasibility.
ST FL #5	2,3,4,5,6	Acquire outside funding to hire a consultant to lead the application process to maintain a Class 5 rating when the City seeks Community Rating System re-certification.	High	BES, BDS, BPS; Parks, POEM, PBOT	City of Portland	**ST Ongoing**	B/C: This ongoing activity is essential for the City as there are limited funds available to accomplish effective mitigation actions. TF: This activity is ongoing demonstrating its feasibility.
ST FL #6	5,6,7	Support Multnomah County Drainage District (MCDD) in the continued calibration and update of hydraulic models for conveyance and internal flood impacts to the four floodplains managed by MCDD #1.	Medium	POEM, BES, BPS	City of Portland, NOAA/NWS	**ST Ongoing**	B/C: Coordinated planning, mapping and modeling ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This project is feasible using existing staff skills, equipment and materials.
ST FL #8	5,7	Identify funding for the design and construction of the Springwater Wetlands Complex, a 30-acre floodplain wetland restoration project in the Lents area of Johnson Creek.	High	BES,BPS, Parks and Recreation	City of Portland, FEMA HMA, NOAA/NWS, NRCS, USACE	**ST Ongoing**	B/C: This ongoing activity is essential for the City as there are limited funds available to accomplish effective mitigation actions. TF: This activity is ongoing demonstrating its feasibility.

Table 5-6-1a Benefit Vs. Cost Analysis

ACTION ID	GOALS	DESCRIPTION	PRIORITIZATION (HIGH, MEDIUM, LOW)	RESPONSIBLE & COORDINATING BUREAUS & AGENCIES	POTENTIAL FUNDING AGENCIES	TIMEFRAME	(B/C) BENEFIT-COSTS (TF) TECHNICAL FEASIBILITY
ST FL #9	3,4,5,6,7	Secure funding to implement the passive flood management projects that are recommended in the Johnson Creek Restoration Plan & other watershed management plans. Coordinate with Portland Development Commission's urban renewal efforts in Lents and with other partners in other parts of the watershed.	High	BES, BP&R, PDC	City of Portland, FEMA HMA, NOAA/NWS, NRCS, USACE	**ST Ongoing**	B/C: This ongoing activity is essential for the City as there are limited funds available to accomplish effective mitigation actions. TF: This activity supports project options and is an ongoing initiative demonstrating its feasibility.
ST FL #10	4,6	Improve definitions and refine standards for stormwater retention in the Storm water Management Manual.	High	BES, BDS, BPS	City of Portland	**ST Ongoing**	B/C: Coordinated planning ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This activity involves effective communication and staff resources; this activity is feasible for the City to complete. This activity is ongoing demonstrating its feasibility.
LT FL #1	4,5,6,7	Increase funding for the Johnson Creek Willing Seller Program; establish willing seller programs in other watersheds where flood hazard and priority restoration areas coexist. **(NFIP Compliance)**	High	BES, BP&R, BPS, Water	City of Portland, FEMA HMA, NRCS	**LT Ongoing**	B/C: This ongoing activity is essential for the City as there are limited funds available to accomplish effective mitigation actions. This program has proved very successful at removing structures from the floodplain. TF: This activity has removed structures from hazard areas and is an ongoing initiative demonstrating its feasibility.
LT FL #3	2,3,5,6	Develop a plan for addressing flooding in the Holgate Lake area. (planning) **(NFIP Compliance)**	High	BES,BDS, BP&R, BPS	City of Portland, FEMA HMA, USACE	**LT Ongoing**	B/C: Coordinated planning ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This activity involves effective communication and staff resources; this activity is feasible for the City to complete. This activity is ongoing demonstrating its feasibility.
LT FL #4	2,5	Improve hydraulic bottleneck that prevents discharge of chlorinated effluent to the Willamette River during high river levels. **(NFIP Compliance)**	High	BES	City of Portland, USACE	**LT**	B/C: Hydraulic bottlenecks develop excess pressure which eliminates water force control due to excessive water volumes beyond facility capacity. This project will effectively mitigate chlorinated effluent discharge in to the Willamette River during high water flow flood events. The City relies heavy on the numerous bridge trestles that span the river systems ensuring access and resource transportation. Upgrading the trestles ensures efficient access and reduces delays in goods and passenger delivery. TF: This project is technically feasible using existing staff skills, equipment, materials and resources as funding becomes available.
LT FL #5	2,3,5,6	As Waterfront Park remodeling is designed, ensure that Portland's downtown property and critical facilities remain protected from floodwaters. (asset management)	High	BP&R, BF&R BPS, BDS	City of Portland	**LT Ongoing**	B/C: This project is essential for sustainability and operations continuity ensuring City infrastructure and the population's remain protected from potential flood impacts during reconstruction ensuring their health and safety. TF: This activity is technically feasible within the community through partnership agreements or memoranda to maximize existing utility infrastructure availability.

Table 5-6-1a Benefit Vs. Cost Analysis

Action ID	Goals	Description	Prioritization (High, Medium, Low)	Responsible & Coordinating Bureaus & Agencies	Potential Funding AGENCIES	Timeframe	(B/C) Benefit-Costs (TF) Technical Feasibility
LT FL #6/#7	2,5,6,7	Partner with Army Corps of Engineers to conduct modeling of the Willamette River upstream of Portland to identify areas that, if acquired or restored, would contribute to mitigate of peak flows in Portland or result in significant reduction of flood damages. **(NFIP Compliance)**	High	BES	City of Portland, NOAA/NWS, USACE	**LT Deferred**	B/C: Coordinated planning, mapping and modeling ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This activity involves effective communication and staff resources; this activity is feasible for the City to complete. This activity is ongoing demonstrating its feasibility.
LT FL #8	2,5,6,7	Develop goals, policies and implementation measures to manage the amount of new impervious surface and remove existing impervious surfaces where appropriate. These goals, policies and measures may be at the citywide, watershed, or sub-watershed level. (planning) **(NFIP Compliance)**	High	BPS, BES, BDS, PBOT	City of Portland, FEMA HMA, FEMA AFG, FP&S, SAFER, NOAA/NWS, NRCS, USACE	**LT Ongoing**	B/C: Coordinated planning ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This activity involves effective communication and staff resources; this activity is feasible for the City to complete. This activity is ongoing demonstrating its feasibility.
LT FL #9	2,5	Upgrade trestles that carry the main conduits of the water delivery system. (Sandy River Crossing interties completed) (asset management)	High	Water	City of Portland, FEMA HMA, USACE	**LT Deferred**	B/C: The City relies heavy on the numerous bridge trestles that span the river systems ensuring access and resource transportation. Upgrading the trestles ensures efficient access and reduces delays in goods and passenger delivery. TF: This project is technically feasible using existing staff skills, equipment, materials and resources as funding becomes available.
FL #10	2,5	Create redundancy in the water delivery system at the three Sandy River crossings by burying conduits under the river (in progress).	Medium	Water	City of Portland	**LT Ongoing**	B/C: Redundant capability is essential for sustainability and operations continuity ensuring City water utility sustainability and the population's health and safety. TF: This activity is technically feasible within the community through partnership agreements or memoranda to maximize existing utility infrastructure availability.
LT FL #11	2,5,6,7	Provide funding for and participate in development of a flood inundation model for the managed floodplains and downtown sea wall. (mapping) **(NFIP Compliance)**	Medium	POEM, BES, Water	City of Portland, FEMA HMA, NOAA/NWS, NRCS, USACE	**LT Ongoing**	B/C: This ongoing activity is essential for the City as there are limited funds available to accomplish effective mitigation actions. TF: This activity supports project options and is an ongoing initiative demonstrating its feasibility.
LT FL #12	2,5	Install a river gauge in the vicinity of the bridge over Johnson Creek at 108th. The gauge should be able to send data to remote monitoring sites.	Medium	POEM , PBOT, Police, Water	City of Portland, NOAA/NWS	**LT Ongoing**	B/C: The river gauge is essential to provide the City with essential early water level fluctuation warning. TF: This project is feasible using existing staff skills, equipment and materials.
LT FL #13	2,5	Install one-way valves on the outlet pipes of the storm inlets on SE Foster Road between 101st and 112th.	Low	PBOT, BES	City of Portland, FEMA HMA, NRCS, USACE	**LT Ongoing**	B/C: The one-way valve will protect the system from reverse flow forces minimizing or eliminating damage impacts. TF: This project is feasible using existing staff skills, equipment and materials.
FL		Complete update to the Johnson Creek Restoration Plan. Develop individual plans for each subwatershed to address the sources of excess stormwater runoff that exacerbates flooding. **(NFIP Compliance)**	High	POEM	City of Portland, USACE	**LT**	B/C: Coordinated planning ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This activity is technically feasible and involves effective communication and staff resources; this activity is feasible for the City to complete.

Table 5-6-1a Benefit Vs. Cost Analysis

Action ID	Goals	Description	Prioritization (High, Medium, Low)	Responsible & Coordinating Bureaus & Agencies	Potential Funding AGENCIES	Timeframe	(B/C) Benefit-Costs (TF) Technical Feasibility
FL	2,5	Establish flood mitigation priorities for critical facilities and residential and commercial buildings located within the 100- year floodplain using survey elevation data. **(NFIP Compliance)**	Low	POEM, All bureaus	City of Portland, FEMA HMA, USACE	**LT**	B/C: This project would reduce risk to infrastructure and residential properties by elevating, relocation, or providing location appropriate measures to reduce flood damage to threatened structures within the floodplain. TF: This activity is technically feasible and involves effective communication and staff resources; this activity is feasible for the City to complete.
ST-LS #1	4,6	Continue to maintain and Improve internal City communications to facilitate coordination of landslide mitigation activities. (education, outreach)	High	BDS, BES, PBOT, Water, BP&R, Risk Management	City of Portland	**ST Ongoing**	B/C: Coordinated planning ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This activity involves effective communication and staff resources; this activity is feasible for the City to complete. This activity is ongoing demonstrating its feasibility.
ST-LS #3	2,5,6	Mitigate Portland's water supply infrastructure from landslide hazards. (asset management)	High	Water	City of Portland, FEMA HMA, USACE	**ST Ongoing**	B/C: The water supply is essential for the entire City populations, survivability, health and safety. TF: This project is technically feasible as funding becomes available to procure engineering/design, procurement and construction capability.
ST-LS # 4	5,6	Initiate more operations and maintenance pilot projects along roads that inform about the development of standards for managing stormwater in ditches in landslide prone areas. (education, outreach	High	BES, PBOT	City of Portland, FEMA HMA, USACE	**ST Ongoing**	B/C: Past Pilot Programs have effectively sustained mitigation outreach efforts with minimal cost and helped build and support area-wide capacity. This activ-ity enables the public to prepare for, respond to and recover from disasters. TF: This low cost activity can be combined with recurring outreach opportunities at meetings where hazard specific information can be presented in small increments. This activity is ongoing demonstrating its feasibility.
LT-LS # 1	2,3,6	Develop a comprehensive landslide map for the City of Portland to identify hazard areas and to improve communications with the public. (mapping)	High	BDS, BPS, Water, BES, PBOT, BP&R	City of Portland	**LT Ongoing**	B/C: Coordinated mapping ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This is feasible using existing resources. The City's possesses GIS infrastructure to easily accomplish this task.
New LT LS #3	1,3,4,6	Evaluate the role of drainage systems in the West Hills, including pipes, streams and drainage ways and options for protecting and improving their functions and increasing their resiliency. (planning)	High	BDS, BPS, Water, BES, PBOT, BP&R	City of Portland	**LT Ongoing**	B/C: Coordinated planning ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This activity involves effective communication and staff resources; this activity is feasible for the City to complete. This activity is ongoing demonstrating its feasibility.
LT LS #4	5,6	Review the effectiveness of existing regulations related to development in landslide hazard areas. (planning)	High	BDS, BPS, BES	City of Portland	**LT Ongoing**	B/C: Coordinated planning ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This activity involves effective communication and staff resources; this activity is feasible for the City to complete. This activity is ongoing demonstrating its feasibility.
LT-LS #6	2,4,5	Employ alternative construction methods such as trenchless construction on City projects to reduce the impact that development can have in landslide prone areas.	Low	BES	City of Portland	**LT Ongoing**	B/C: Alternative construction methods dramatically reduce soil disturbance impacts, which prevents or reduces landslide susceptibility. TF: This project is feasible using existing staff skills, equipment and materials.

Table 5-6-1a Benefit Vs. Cost Analysis

ACTION ID	GOALS	DESCRIPTION	PRIORITIZATION (HIGH, MEDIUM, LOW)	RESPONSIBLE & COORDINATING BUREAUS & AGENCIES	POTENTIAL FUNDING AGENCIES	TIMEFRAME	(B/C) BENEFIT-COSTS (TF) TECHNICAL FEASIBILITY
LT LS #7	2,4,5,6	Continue development of standards for small pump stations as an alternative to gravity sewers in accessible or high risk areas.	Low	BES, BDS	City of Portland	**LT Ongoing**	B/C: Coordinated planning ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This activity involves effective communication and staff resources; this activity is feasible for the City to complete. This activity is ongoing demonstrating its feasibility.
ER #	2.5	Develop recommendations for high and low ranking streamside plants that provide more erosion control, such as reducing erosion from high water and wave actions.	Medium	BES, BP&R, BPS	City of Portland, FEMA HMA, FEMA AFG, FP&S, NRCS	**ST**	B/C: This project would reduce erosion risk to infrastructure and residential properties using effective native vegetation bank stabilization measures to reduce erosion damage to threatened structures. TF: This activity is technically feasible and involves effective communication and staff resources; this activity is feasible for the City to complete.
ER#	2,5	Implement projects that *retain native vegetation, i*ncrease vegetation diversity and increase the complexity of the vegetation strata (having three vegetation strata: herbs, shrubs, trees).	High	BES, BDS	City of Portland, FEMA AFG, FP&S, NRCS	**ST**	B/C: This project would reduce erosion risk to infrastructure and residential properties using effective native vegetation bank stabilization measures to reduce erosion damage to threatened structures. TF: This activity is technically feasible and involves effective communication and staff resources; this activity is feasible for the City to complete.
ER#	2,3.5.6	Implement policies to increase the extent of coverage of the Greenway zones along the rivers and further limit proposed activities within these areas.	High	Mosaic Consulting Sheriff River Patrol	City of Portland	**ST**	B/C: Coordinated legislation ensures consistency, enforcement and protection to the City's population and resource expenditure reduction. TF: This activity is technically feasible and involves effective communication and staff resources; this activity is feasible for the City to complete.
ER#	2,5	Develop standards for soil backfill in vegetated areas, especially sloped areas. (planning)	High	BES	City of Portland, FEMA HMA, FEMA AFG, FP&S, SAFER, DHS, NRCS	**LT**	B/C: This project would reduce erosion risk to infrastructure and residential properties using effective native vegetation bank stabilization measures to reduce erosion damage to threatened structures. TF: This activity is technically feasible and involves effective communication and staff resources; this activity is feasible for the City to complete.
ER#	2,5	Establish regulations that prevent installation of slopes steeper than 3:1 and prohibit development on slopes steeper than 3:1. (planning)	High	BDS, BPS, BES	City of Portland	**LT**	B/C: Coordinated legislation ensures consistency, enforcement and protection to the City's population and resource expenditure reduction. TF: This activity is technically feasible and involves effective communication and staff resources; this activity is feasible for the City to complete.
ER#	2,5	Implement projects that layback and/or regrade riverbank slopes and secure wetland sod mats composed of native emergent/grasses, etc.	High	BP&R	City of Portland FEMA HMA, FEMA AFG, FP&S, SAFER, NRCS	**LT**	B/C: This project would reduce erosion risk to infrastructure and residential properties using effective native vegetation bank stabilization measures to reduce erosion damage to threatened structures. TF: This activity is technically feasible and involves effective communication and staff resources; this activity is feasible for the City to complete.
ER#	2,5	Construct and install bio-engineered slope protective measures to reduce or eliminate erosion	High	BP&R	City of Portland, City of Portland FEMA HMA, FEMA AFG, FP&S, SAFER, NRCS	**LT**	B/C: This project would reduce erosion risk to infrastructure and residential properties using effective native vegetation bank stabilization measures to reduce erosion damage to threatened structures. TF: This activity is technically feasible and involves effective communication and staff resources; this activity is feasible for the City to complete.
ER#	2,5	Implement projects that increase large wood structures that act to soften the effect of wave action on shorelines as well as provide habitat for migrating salmonids.	High	BES	City of Portland, City of Portland FEMA HMA, FEMA AFG, FP&S, SAFER, NRCS, USACE	**LT**	B/C: This project would reduce erosion risk to infrastructure and residential properties using effective native vegetation bank stabilization measures to reduce erosion damage to threatened structures. TF: This activity is technically feasible and involves effective communication and staff resources; this activity is feasible for the City to complete.

Table 5-6-1a Benefit Vs. Cost Analysis

Action ID	Goals	Description	Prioritization (High, Medium, Low)	Responsible & Coordinating Bureaus & Agencies	Potential Funding AGENCIES	Timeframe	(B/C) Benefit-Costs (TF) Technical Feasibility
ER#	2,5	Secure large wood [boles w/ attached root wads] or log rafts to reduce high wave action that can result in erosion.	High	BP&R	City of Portland, City of Portland FEMA HMA, FEMA AFG, FP&S, SAFER, NRCS, USACE	**LT**	B/C: This project would reduce erosion risk to infrastructure and residential properties using effective native vegetation bank stabilization measures to reduce erosion damage to threatened structures. TF: This activity is technically feasible and involves effective communication and staff resources; this activity is feasible for the City to complete.
ST WF #1	5,6	Consolidate unassigned and/or unmanaged vegetated areas owned by the City under a single land management umbrella. (asset management)	Low	BP&R, BES, Water, PBOT, BGS	City of Portland	**ST**	B/C: Coordinated planning ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This activity involves effective communication and staff resources; this activity is feasible for the City to complete. This activity is ongoing demonstrating its feasibility.
ST WF #2	3,5,6	Procure funding for management of vegetated natural areas with high wildfire danger, including public and private properties.	High	BP&R, BF&R, BPS, BES, PBOT BGS	City of Portland, FEMA FP&S, NRCS	**ST Ongoing**	B/C: This ongoing activity is essential for the City as there are limited funds available to accomplish effective mitigation actions. TF: This activity is ongoing demonstrating its feasibility.
ST WF #4	3,5,6	Provide wildfire management training to staff. (education, outreach)	High	BF&R, BP&R, BES, Water, PBOT	City of Portland, FEMA AFG, FP&S, SAFER	**ST**	B/C: Consistent raining ensures individuals develop tuned situational response that greatly reduces hesitation during intense emergency situations. TF: This project is feasible using existing staff skills, equipment and materials.
ST WF #5	5,6,7	Amend the Portland Plant List and other related City plant lists and landscaping guides to include/identify fire resistant native plants and planting strategies that could be encouraged or required in local landscaping. (planning)	Low	BPS, BDS, BF&R BP&R, BES, PBOT	City of Portland, FEMA AFG, FP&S, SAFER	**ST Ongoing**	B/C: Coordinated planning ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This activity involves effective communication and staff resources; this activity is feasible for the City to complete. This activity is ongoing demonstrating its feasibility.
ST WF #6	5,6	Integrate, as appropriate, fire prevention goals and provisions into City policies, plans and codes. Identify and address ambiguities or conflicts among city requirements. (planning)	High	BPS, BDS, BF&R, BP&R, BES, PBOT	City of Portland	**ST Ongoing**	B/C: Coordinated planning ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This activity involves effective communication and staff resources; this activity is feasible for the City to complete. This activity is ongoing demonstrating its feasibility.
ST WF #7	2,6	Identify conditions of approval and mitigation strategies that could be applied to new development or redevelopment in high risk areas.	High	BDS, BPS, BP&R, BF&R, BES, PBOT	City of Portland	**ST Ongoing**	B/C: Coordinated technical guidance ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This activity involves effective communication and staff resources; this activity is feasible for the City to complete. This activity is ongoing demonstrating its feasibility.
ST WF #9	2,3,5	Improve the system for identifying new construction in areas subject to wildfires and communicating this information to the affected land owners. (planning)	High	BDS, BF&R, Water, PBOT, ONI, BPS	City of Portland, FEMA FP&S	**ST Ongoing**	B/C: Coordinated technical guidance ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This activity involves effective communication and staff resources; this activity is feasible for the City to complete. This activity is ongoing demonstrating its feasibility.

Table 5-6-1a Benefit Vs. Cost Analysis

Action ID	Goals	Description	Prioritization (High, Medium, Low)	Responsible & Coordinating Bureaus & Agencies	Potential Funding AGENCIES	Timeframe	(B/C) Benefit-Costs (TF) Technical Feasibility
ST WF #10	1,3,6	Conduct systematic reviews of Portland's large, publicly owned, wildland tracts regarding fire safety and ecological health to ensure informed land management decisions. (asset management)	High	BP&R, BES, BF&R, Water, BPS, PBOT, ONI	City of Portland	**ST**	B/C: Coordinated technical guidance ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This project is feasible using existing staff skills, equipment and materials.
ST WF #11	2,3,7	Adopt the national "Fire Danger Rating System" and install the signs at key points in the City.	High	BF&R, ONI	City of Portland	**ST**	B/C: Coordinated technical guidance ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This project is feasible using existing staff skills, equipment and materials.
ST WF #12	3,5,6	Implement a neighborhood wildland interface disaster planning program. (education, outreach)	Medium	POEM, ONI, BF&R, Police	City of Portland, FEMA FP&S	**ST**	B/C: Coordinated planning ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This activity involves effective communication and staff resources; this activity is feasible for the City to complete. This activity is ongoing demonstrating its feasibility.
ST WF #13	3,5	Review and potentially refine City contract specifications for machinery operations during "Red Flag" weather conditions. (asset management)	Low	BF&R, BES, BP&R, Water, PBOT	City of Portland	**ST**	B/C: Coordinated technical guidance ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This project is feasible using existing staff skills, equipment and materials.
ST WF #14	1-7	Convene a standing wildland interface fire technical group. (planning)	High	BF&R, BP&R, BES, POEM, Water, PBOT, BDS, BPS	City of Portland, FEMA AFG, FP&S, SAFER	**ST**	B/C: Coordinated technical guidance ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This activity involves effective communication and staff resources; this activity is feasible for the City to complete. This activity is ongoing demonstrating its feasibility.
ST WF #15	5,6	Index City wildfire mitigation plans and activities. (asset management)	Low	BF&R, BP&R, BES POEM, PBOT, Metro, BDS, BPS	City of Portland	**ST Ongoing**	B/C: Coordinated planning ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This activity involves effective communication and staff resources; this activity is feasible for the City to complete. This activity is ongoing demonstrating its feasibility.
WF	2,4,5,6	Develop and implement protocol for defining and mapping Wildland Urban Interface Zones and develop recommended policies, regulations and landscape options for incorporation into City plans and programs. (planning)	High	BF&R, BP&R, BES, POEM, PBOT, Metro, BDS, BPS	City of Portland, FEMA AFG, FP&S, SAFER	**ST**	B/C: Coordinated planning ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This activity involves effective communication and staff resources; this activity is feasible for the City to complete. This activity is ongoing demonstrating its feasibility.
ST WF #16	2,6	Identify water grid engineering requirements for firefighting in wildfire areas. (asset management)	Medium	BF&R, Water	City of Portland, FEMA AFG, FP&S, SAFER	**LT Ongoing**	B/C: Resource pre-identification ensures resource availability during hazard events. Available hazard appropriate mapping enables effective planning and resource acquisition. TF: Feasible as financial resources become available. LiDAR will greatly enhance the City's risk and vulnerability analysis through expanded mapping capability.

Table 5-6-1a Benefit Vs. Cost Analysis

ACTION ID	GOALS	DESCRIPTION	PRIORITIZATION (HIGH, MEDIUM, LOW)	RESPONSIBLE & COORDINATING BUREAUS & AGENCIES	POTENTIAL FUNDING AGENCIES	TIMEFRAME	(B/C) BENEFIT-COSTS (TF) TECHNICAL FEASIBILITY
LT WF #2	3,6,7	Review the feasibility of adopting portions of nationally recognized wildfire interface codes to strengthen building standards in wildfire risk areas.	Low	BF&R, BDS	City of Portland, FEMA AFG, FP&S, SAFER	**LT Ongoing**	B/C: Coordinated planning ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This activity involves effective communication and staff resources; this activity is feasible for the City to complete. This activity is ongoing demonstrating its feasibility.
LT WF #3	1,6	Design and conduct a study to determine the effectiveness of maintenance agreements that are established when new land divisions are approved to manage vegetation in open space tracts.	High	BDS, BF&R, BP&R, BPS BES, PBOT, ONI	City of Portland	**LT**	B/C: Open space ensures no infrastructure or population occurs in known hazard areas. TF: Feasible as financial resources become available. LiDAR will greatly enhance the City's risk and vulnerability analysis through expanded mapping capability.
LT WF #4	1,4,6	Complete an assessment to characterize high priority wildfire risk areas and recommend specific mitigation strategies.	Medium	BF&R, BP&R, BES, BPS, BDS, Water, PBOT	City of Portland, FEMA AFG, FP&S, SAFER	**LT Ongoing**	B/C: Pre-identification ensures that structures are not placed inappropriately and are built with the hazard as a focus. Developing a mapping committee ensures a comprehensive approach to determining the City's mapping needs. TF: Feasible as financial resources become available. LiDAR will greatly enhance the City's risk and vulnerability analysis through expanded mapping capability.
LT WF #5	3,6,7	Explore avenues for funding wildfire interface home construction upgrades to low income homeowners.	Low	BF&R, BDS, ONI	City of Portland, FEMA HMA. AFG, FP&S, SAFER	**LT Ongoing**	B/C: This ongoing activity is essential for the City as there are limited funds available to accomplish effective mitigation actions. TF: This activity is ongoing demonstrating its feasibility.
WF	2,4,5,6	Act upon all Mitigation Actions outlined in the Wildfire GAP Analysis Report	High	BDS, BF&R, BPS, BP&R, BES, PBOT, ONI	City of Portland, FEMA AFG, FP&S, SAFER	**LT**	B/C: Coordinated planning ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This activity involves effective communication and staff resources; this activity is feasible for the City to complete. This activity is ongoing demonstrating its feasibility.
IS #	2,5,6	Update Invasive Species Plants List by consolidating nuisance and prohibited plant lists into one "Nuisance Plants List" and assigning priority ranks to the Nuisance Plants List.	High	BPS	City of Portland, FEMA FP&S, NRCS	**ST**	B/C: Coordinated planning ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This activity is technically feasible and involves effective communication and staff resources; this activity is feasible for the City to complete.
IS #	2,5,6	Clarify zoning regulations to require removal of plants on the Nuisance Plants List in the Environmental, Greenway and Pleasant Valley Natural Resources Overlay Zones and the Columbia South Shore and Johnson Creek Basin Plan Districts.	High Completed Jan2010	BPS	City of Portland	**ST**	B/C: Coordinated legislation ensures consistency, enforcement and protection to the City's population and resource expenditure reduction. TF: This activity is technically feasible and involves effective communication and staff resources; this activity is feasible for the City to complete.
IS #	2,5,6	Initiate a process to ensure the Erosion Control Manual be made consistent with City goals to control and eradicate invasive plants. (planning)	Low	BPS	City of Portland	**LT**	B/C: Coordinated planning ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This activity is technically feasible and involves effective communication and staff resources; this activity is feasible for the City to complete.

Table 5-6-1a Benefit Vs. Cost Analysis

ACTION ID	GOALS	DESCRIPTION	PRIORITIZATION (HIGH, MEDIUM, LOW)	RESPONSIBLE & COORDINATING BUREAUS & AGENCIES	POTENTIAL FUNDING AGENCIES	TIMEFRAME	(B/C) BENEFIT-COSTS (TF) TECHNICAL FEASIBILITY
IS #	2,5,6	Initiate a process to ensure the Tree and Landscaping Manual, the Recommended Street Tree List and the Stormwater Management Manual be made consistent with City goals to control and eradicate invasive plants. (planning)	High	BPS	City of Portland	**LT**	B/C: Coordinated planning ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This activity is technically feasible and involves effective communication and staff resources; this activity is feasible for the City to complete.
IS #	2,5,6	Coordinate with the Portland Plan project to help ensure that invasive species are addressed in the Comprehensive Plan update and Portland Plan work plan. (planning)	High	BPS	City of Portland	**LT**	B/C: Coordinated planning ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This activity is technically feasible and involves effective communication and staff resources; this activity is feasible for the City to complete.
IS #	2,5,6	Research the feasibility of establishing a local noxious or invasive weed law.	High	BPS	City of Portland	**LT**	B/C: Coordinated legislation ensures consistency, enforcement and protection to the City's population and resource expenditure reduction. TF: This activity is technically feasible and involves effective communication and staff resources; this activity is feasible for the City to complete.
LT V #1	6,7	Work with the state and other impacted jurisdictions to implement and update the various volcano Inter-Agency Coordination Plans.	Low	POEM	City of Portland	**LT Ongoing**	B/C: Coordinated planning ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This activity involves effective communication and staff resources; this activity is feasible for the City to complete. This activity is ongoing demonstrating its feasibility.
V	2,7	Work with the state and other impacted jurisdictions to implement and update the various volcano Inter-Agency Coordination Plans.	Low	POEM	City of Portland	**LT**	B/C: Coordinated planning ensures effective damage avoidance or reduction and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This activity involves effective communication and staff resources; this activity is feasible for the City to complete. This activity is ongoing demonstrating its feasibility.

5.7 CONTINUED PUBLIC INVOLVEMENT

DMA 2000 Requirements: Plan Maintenance Process - Continued Public Involvement

> **Requirement §201.6(c)(4)(iii):** [The plan maintenance process shall include a] discussion on how the community will continue public participation in the plan maintenance process.

In the past five years of implementing the mitigation plan, the involved bureaus conducted outreach activities related to the 2004 NHMP projects. These activities addressed many of the mitigation action items and individual bureau projects.

Appendix C details the public involvement mechanisms (page C-4, Table C-2-1a) and the Planning Team meeting and tasks (C.2.2). Appendix D includes meeting information during the four month contracted update of the plan. Appendix F outlines the planning maintenance documents and expected procedures.

The City is dedicated to involving the public directly in the continual reshaping and updating of the NHMP. The Planning Team EMSC members are responsible for the annual review and update of the plan.

POEM will continue to identify opportunities for the public's engagement in implementation and NHMP update. Public participation will continue to be invited through a series of presentations to community organizations, such as neighborhood associations, business and industry associations and hazard specific councils and commissions. Copies of the plan will be posted on the POEM website www.portlandonline.com/oem and will be available there during update cycles. This website also contains an email address and phone number that the public can use if they have comments or concerns.

The number one priority of the 2010 plan is to continue to involve the public in updating the Natural Hazard Mitigation Plan. The first order of business after the update is approved by federal, state and City management will be to convene a meeting of the Hazard Mitigation Planning Team(HMPT) to review an annual calendar of events and opportunities for collaboration on mitigation outreach and education. Utilizing the Public Involvement Advisory Council 09 Principles as a guide, the HMPT will establish a schedule to implement this action item. In addition a citizen mitigation action plan will be created. As a part of this process, community members will prioritize the list of actions that they can implement or promote.

CITY OF PORTLAND UPDATE, LOCAL MITIGATION PLAN REVIEW CROSSWALK

LOCAL MITIGATION PLAN REVIEW SUMMARY

The plan cannot be approved if the plan has not been formally adopted. Each requirement includes separate elements. All elements of the requirement must be rated "Satisfactory" in order for the requirement to be fulfilled and receive a score of "Satisfactory." Elements of each requirement are listed on the following pages of the Plan Review Crosswalk. A "Needs Improvement" score on elements shaded in gray (recommended but not required) will not preclude the plan from passing. Reviewer's comments must be provided for requirements receiving a **"Needs Improvement"** score.

Please check one of the following for each requirement.

N – Needs Improvement: The plan does not meet the minimum for the requirement. Reviewer's comments must be provided.

S – Satisfactory: The plan meets the minimum for the requirement. Reviewer's comments are encouraged, but not required.

Prerequisite(s) (Check Applicable Box)	NOT MET	MET
1. Adoption by the Local Governing Body: §201.6(c)(5) OR		
2. Multi-Jurisdictional Plan Adoption: §201.6(c)(5) **AND**		
3. Multi-Jurisdictional Planning Participation: §201.6(a)(3)		

Planning Process	N	S
4. Documentation of the Planning Process: §201.6(b) and §201.6(c)(1)		

Risk Assessment	N	S
5. Identifying Hazards: §201.6(c)(2)(i)		
6. Profiling Hazards: §201.6(c)(2)(i)		
7. Assessing Vulnerability: Overview: §201.6(c)(2)(ii)		
8. Assessing Vulnerability: Addressing Repetitive Loss Properties. §201.6(c)(2)(ii)		
9. Assessing Vulnerability: Identifying Structures, Infrastructure, and Critical Facilities: §201.6(c)(2)(ii)(B)		
10. Assessing Vulnerability: Estimating Potential Losses: §201.6(c)(2)(ii)(B)		
11. Assessing Vulnerability: Analyzing Development Trends: §201.6(c)(2)(ii)(C)		
12. Multi-Jurisdictional Risk Assessment: §201.6(c)(2)(iii)		

Mitigation Strategy	N	S
13. Local Hazard Mitigation Goals: §201.6(c)(3)(i)		
14. Identification and Analysis of Mitigation Actions: §201.6(c)(3)(ii)		
15. Identification and Analysis of Mitigation Actions: NFIP Compliance. §201.6(c)(3)(ii)		
16. Implementation of Mitigation Actions: §201.6(c)(3)(iii)		
17. Multi-Jurisdictional Mitigation Actions: §201.6(c)(3)(iv)		

Plan Maintenance Process	N	S
18. Monitoring, Evaluating, and Updating the Plan: §201.6(c)(4)(ii)		
19. Incorporation into Existing Planning Mechanisms: §201.6(c)(4)(ii)		
20. Continued Public Involvement: §201.6(c)(4)(iii)		

Additional State Requirements*	N	S
Insert State Requirement		
Insert State Requirement		
Insert State Requirement		

*States that have additional requirements can add them in the appropriate sections of the *Local Multi-Hazard Mitigation Planning Guidance* or create a new section and modify this Plan Review Crosswalk to record the score for those requirements.

LOCAL MITIGATION PLAN APPROVAL STATUS

PLAN NOT APPROVED	
See Reviewer's Comments	
PLAN APPROVED	

SCORING SYSTEM

CITY OF PORTLAND UPDATE, LOCAL MITIGATION PLAN REVIEW CROSSWALK

Local Mitigation Plan Review and Approval Status

Jurisdiction: City of Portland, Oregon	**Title of Plan:** City of Portland Hazard Mitigation Plan Update	**Date of Plan:** October 27, 2010
Local Point of Contact: Patty Rueter	**Address:**	
Title: Planning Manager	1001 SW 5th Avenue, Suite 650 Portland, Oregon 97204	
Agency: Portland Office of Emergency Management		
Phone Number: 503.823.3809	**E-Mail:** patty.rueter@portlandoregon.gov	

State Reviewer:	Title:	Date:

FEMA Reviewer:	Title:	Date:
Date Received in FEMA Region [Insert #]		
Plan Not Approved		
Plan Approved		
Date Approved		

	NFIP Status*			
Jurisdiction:	**Y**	**N**	**N/A**	**CRS Class**
1. City of Portland, Oregon	X			5
2.				
3.				
4.				
5. [ATTACH PAGE(S) WITH ADDITIONAL JURISDICTIONS]				

*** Notes:** **Y = Participating** **N = Not Participating** **N/A = Not Mapped**

CITY OF PORTLAND UPDATE, LOCAL MITIGATION PLAN REVIEW CROSSWALK

PREREQUISITE(S)

1. Adoption by the Local Governing Body

Requirement §201.6(c)(5): *[The local hazard mitigation plan **shall** include] documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan (e.g., City Council, County Commissioner, Tribal Council).*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE NOT MET	SCORE MET
A. Has the local governing body adopted new or updated plan?	Appendix B			
B. Is supporting documentation, such as a resolution, included?	Appendix B			
		SUMMARY SCORE		

2. Multi-Jurisdictional Plan Adoption

Requirement §201.6(c)(5): *For multi-jurisdictional plans, each jurisdiction requesting approval of the plan **must** document that it has been formally adopted.*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE NOT MET	SCORE MET
A. Does the new or updated plan indicate the specific jurisdictions represented in the plan?	N/A			
B. For each jurisdiction, has the local governing body adopted the new or updated plan?	N/A			
C. Is supporting documentation, such as a resolution, included for each participating jurisdiction?	N/A			
		SUMMARY SCORE		

3. Multi-Jurisdictional Planning Participation

Requirement §201.6(a)(3): *Multi-jurisdictional plans (e.g., watershed plans) may be accepted, as appropriate, as long as each jurisdiction has participated in the process … Statewide plans will not be accepted as multi-jurisdictional plans.*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE NOT MET	SCORE MET
A. Does the new or updated plan describe how each jurisdiction participated in the plan's development?	N/A			
B. Does the updated plan identify all participating jurisdictions, including new, continuing, and the jurisdictions that no longer participate in the plan?	N/A			
		SUMMARY SCORE		

CITY OF PORTLAND UPDATE, LOCAL MITIGATION PLAN REVIEW CROSSWALK

PLANNING PROCESS: *§201.6(b): An open public involvement process is essential to the development of an effective plan.*

4. Documentation of the Planning Process

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)(1): *[The plan* ***shall*** *document] 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.*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the plan provide a narrative description of the process followed to prepare the new or updated plan?	Appendix C			
B. Does the new or updated plan indicate who was involved in the current planning process? (For example, who led the development at the staff level and were there any external contributors such as contractors? Who participated on the plan committee, provided information, reviewed drafts, *etc.*?)	Page i Appendix C Appendix D			
C. Does the new or updated plan indicate how the public was involved? (Was the public provided an opportunity to comment on the plan during the drafting stage and prior to the plan approval?)	Appendix D			
D. Does the new or updated plan discuss the opportunity for neighboring communities, agencies, businesses, academia, nonprofits, and other interested parties to be involved in the planning process?	Page i Section 5.7 Appendix C Appendix D			
E. Does the planning process describe the review and incorporation, if appropriate, of existing plans, studies, reports, and technical information?	Section 4 Section 5 Appendix F			
F. Does the updated plan document how the planning team reviewed and analyzed each section of the plan and whether each section was revised as part of the update process?	Appendix C			
		SUMMARY SCORE		

CITY OF PORTLAND UPDATE, LOCAL MITIGATION PLAN REVIEW CROSSWALK

RISK ASSESSMENT: *§201.6(c)(2): The plan shall include 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.*

5. Identifying Hazards

Requirement §201.6(c)(2)(i): *[The risk assessment **shall** include a] description of the type … of all natural hazards that can affect the jurisdiction.*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the new or updated plan include a description of the types of all natural hazards that affect the jurisdiction?	Section 3			
		SUMMARY SCORE		

6. Profiling Hazards

Requirement §201.6(c)(2)(i): *[The risk assessment **shall** include a] description of the … 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.*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the risk assessment identify the location (*i.e.*, geographic area affected) of each natural hazard addressed in the new or updated plan?	Section 3			
B. Does the risk assessment identify the extent (*i.e.*, magnitude or severity) of each hazard addressed in the new or updated plan?	Section 3			
C. Does the plan provide information on previous occurrences of each hazard addressed in the new or updated plan?	Section 3			
D. Does the plan include the probability of future events (*i.e.*, chance of occurrence) for each hazard addressed in the new plan?	Section 3			
		SUMMARY SCORE		

CITY OF PORTLAND UPDATE, LOCAL MITIGATION PLAN REVIEW CROSSWALK

7. Assessing Vulnerability: Overview

Requirement §201.6(c)(2)(ii): *[The risk assessment **shall** include 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.*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the new or updated plan include an overall summary description of the jurisdiction's vulnerability to each hazard?	Section 4			
B. Does the new or updated plan address the impact of each hazard on the jurisdiction?	Section 4			
		SUMMARY SCORE		

8. Assessing Vulnerability: Addressing Repetitive Loss Properties

Requirement §201.6(c)(2)(ii): *[The risk assessment] **must** also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged floods.*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the new or updated plan describe vulnerability in terms of the types and numbers of *repetitive loss properties* located in the identified hazard areas?	Section 4.3			
		SUMMARY SCORE		

9. Assessing Vulnerability: Identifying Structures

Requirement §201.6(c)(2)(ii)(A): *The plan **should** describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area … .*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the new or updated plan describe vulnerability in terms of the types and numbers of existing buildings, infrastructure, and critical facilities located in the identified hazard areas?	Section 4.3.2 Section 4.6			
B. Does the new or updated plan describe vulnerability in terms of the types and numbers of future buildings, infrastructure, and critical facilities located in the identified hazard areas?	Section 4.3.3 Section 4.4 Section 4.6			
		SUMMARY SCORE		

CITY OF PORTLAND UPDATE, LOCAL MITIGATION PLAN REVIEW CROSSWALK

10. Assessing Vulnerability: Estimating Potential Losses

Requirement §201.6(c)(2)(ii)(B): *[The plan **should** describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate … .*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the new or updated plan estimate potential dollar losses to vulnerable structures?	Section 4.4 Section 4.5			
B. Does the new or updated plan describe the methodology used to prepare the estimate?	Section 4.4			
		SUMMARY SCORE		

11. Assessing Vulnerability: Analyzing Development Trends

Requirement §201.6(c)(2)(ii)(C): *[The plan **should** describe vulnerability in terms of] 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.*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the new or updated plan describe land uses and development trends?	Section 4.6.7			
		SUMMARY SCORE		

12. Multi-Jurisdictional Risk Assessment

Requirement §201.6(c)(2)(iii): *For multi-jurisdictional plans, the risk assessment **must** assess each jurisdiction's risks where they vary from the risks facing the entire planning area.*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the new or updated plan include a risk assessment for each participating jurisdiction as needed to reflect unique or varied risks?	N/A			
		SUMMARY SCORE		

CITY OF PORTLAND UPDATE, LOCAL MITIGATION PLAN REVIEW CROSSWALK

MITIGATION STRATEGY: *§201.6(c)(3): The plan shall include 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.*

13. Local Hazard Mitigation Goals

Requirement §201.6(c)(3)(i): *[The hazard mitigation strategy **shall** include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A Does the new or updated plan include a description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards?	Section 5.2			
		SUMMARY SCORE		

14. Identification and Analysis of Mitigation Actions

Requirement §201.6(c)(3)(ii): *[The mitigation strategy **shall** include 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.*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the new or updated plan identify and analyze a comprehensive range of specific mitigation actions and projects for each hazard?	Section 5			
B Do the identified actions and projects address reducing the effects of hazards on new buildings and infrastructure?	Section 5			
C. Do the identified actions and projects address reducing the effects of hazards on existing buildings and infrastructure?	Section 5			
		SUMMARY SCORE		

CITY OF PORTLAND UPDATE, LOCAL MITIGATION PLAN REVIEW CROSSWALK

15. Identification and Analysis of Mitigation Actions: National Flood Insurance Program (NFIP) Compliance

Requirement: §201.6(c)(3)(ii): *[The mitigation strategy] must also address the jurisdiction's participation in the National Flood Insurance Program (NFIP), and continued compliance with NFIP requirements, as appropriate.*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the new or updated plan describe the jurisdiction (s) participation in the NFIP?	Section 3.3.3 Appendix I			
B. Does the mitigation strategy identify, analyze and prioritize actions related to continued compliance with the NFIP?	Section 3.3.3.3 Section 5			
		SUMMARY SCORE		

16. Implementation of Mitigation Actions

Requirement: §201.6(c)(3)(iii): *[The mitigation strategy section **shall** include] an action plan describing how the actions identified in section (c)(3)(ii) 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.*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the new or updated mitigation strategy include how the actions are prioritized? (For example, is there a discussion of the process and criteria used?)	Section 1 Section 5.5			
B. Does the new or updated mitigation strategy address how the actions will be implemented and administered, including the responsible department, existing and potential resources and the timeframe to complete each action?	Section 5			
C. Does the new or updated prioritization process include an emphasis on the use of a cost-benefit review to maximize benefits?	Section 5.6.1 Table 5-6-1a Appendix E			
D. Does the updated plan identify the completed, deleted or deferred mitigation actions as a benchmark for progress, and if activities are unchanged (*i.e.*, deferred), does the updated plan describe why no changes occurred?	Section 1.A.3 Appendix C Table C-4a			
		SUMMARY SCORE		

CITY OF PORTLAND UPDATE, LOCAL MITIGATION PLAN REVIEW CROSSWALK

17. Multi-Jurisdictional Mitigation Actions

Requirement §201.6(c)(3)(iv): *For multi-jurisdictional plans, there **must** be identifiable action items specific to the jurisdiction requesting FEMA approval or credit of the plan.*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A Does the new or updated plan include identifiable action items for each jurisdiction requesting FEMA approval of the plan?	N/A			
B. Does the updated plan identify the completed, deleted or deferred mitigation actions as a benchmark for progress, and if activities are unchanged (*i.e.*, deferred), does the updated plan describe why no changes occurred?	N/A			
		SUMMARY SCORE		

PLAN MAINTENANCE PROCESS

18. Monitoring, Evaluating, and Updating the Plan

Requirement §201.6(c)(4)(i): *[The plan maintenance process **shall** include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the new or updated plan describe the method and schedule for monitoring the plan, including the responsible department?	Appendix F			
B. Does the new or updated plan describe the method and schedule for evaluating the plan, including how, when and by whom (*i.e.* the responsible department)?	Appendix F			
C. Does the new or updated plan describe the method and schedule for updating the plan within the five-year cycle?	Section 5.7 Appendix F			
		SUMMARY SCORE		

CITY OF PORTLAND UPDATE, LOCAL MITIGATION PLAN REVIEW CROSSWALK

19. Incorporation into Existing Planning Mechanisms

Requirement §201.6(c)(4)(ii): *[The plan **shall** include 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.*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the new or updated plan identify other local planning mechanisms available for incorporating the mitigation requirements of the mitigation plan?	Section 4 Section 4.6.7 Section 5			
B. Does the new or updated plan include a process by which the local government will incorporate the mitigation strategy and other information contained in the plan (*e.g.*, risk assessment) into other planning mechanisms, when appropriate?	Section 4.6 Section 4.6.7			
C. Does the updated plan explain how the local government incorporated the mitigation strategy and other information contained in the plan (*e.g.*, risk assessment) into other planning mechanisms, when appropriate?	Section 3 Section 4			
		SUMMARY SCORE		

20. Continued Public Involvement

Requirement §201.6(c)(4)(iii): *[The plan maintenance process **shall** include a] discussion on how the community will continue public participation in t plan maintenance process.*

Element	Location in the Plan (section or annex and page #)	Reviewer's Comments	SCORE N	SCORE S
A. Does the new or updated plan explain how continued public participation will be obtained? (For example, will there be public notices, an on-going mitigation plan committee, or annual review meetings with stakeholders?)	Section 5.7			
		SUMMARY SCORE		

CITY OF PORTLAND UPDATE, LOCAL MITIGATION PLAN REVIEW CROSSWALK

MATRIX A: PROFILING HAZARDS

This matrix can assist FEMA and the State in scoring each hazard. Local jurisdictions may find the matrix useful to ensure that their plan addresses each natural hazard that can affect the jurisdiction. **Completing the matrix is not required**.

Note: First, check which hazards are identified in requirement §201.6(c)(2)(i). Then, place a checkmark in either the N or S box for each** applicable **hazard. An "N" for any element of any identified hazard will result in a "Needs Improvement" score for this requirement. List the hazard and its related shortcoming in the comments section of the Plan Review Crosswalk.

Hazard Type	Hazards Identified Per Requirement §201.6(c)(2)(i)	A. Location		B. Extent		C. Previous Occurrences		D. Probability of Future Events	
	Yes	N	S	N	S	N	S	N	S
Avalanche	☐	☐	☐	☐	☐	☐	☐	☐	☐
Coastal Erosion	☐	☐	☐	☐	☐	☐	☐	☐	☐
Coastal Storm	☐	☐	☐	☐	☐	☐	☐	☐	☐
Dam Failure	☐	☐	☐	☐	☐	☐	☐	☐	☐
Drought	☐	☐	☐	☐	☐	☐	☐	☐	☐
Earthquake	☒	☐	☒	☐	☒	☐	☒	☐	☒
Expansive Soils	☐	☐	☐	☐	☐	☐	☐	☐	☐
Levee Failure	☐	☐	☐	☐	☐	☐	☐	☐	☐
Flood	☒	☐	☒	☐	☒	☐	☒	☐	☒
Hailstorm	☐	☐	☐	☐	☐	☐	☐	☐	☐
Hurricane	☐	☐	☐	☐	☐	☐	☐	☐	☐
Land Subsidence	☐	☐	☐	☐	☐	☐	☐	☐	☐
Landslide	☒	☐	☒	☐	☒	☐	☒	☐	☒
Severe Winter Storm	☐	☐	☐	☐	☐	☐	☐	☐	☐
Tornado	☐	☐	☐	☐	☐	☐	☐	☐	☐
Tsunami	☐	☐	☐	☐	☐	☐	☐	☐	☐
Volcano	☒	☐	☒	☐	☒	☐	☒	☐	☒
Wildfire	☒	☐	☒	☐	☒	☐	☒	☐	☒
Windstorm	☐	☐	☐	☐	☐	☐	☐	☐	☐
Other Erosion	☒	☐	☒	☐	☒	☐	☒	☐	☒
Other Invasive Plant Species	☒	☐	☒	☐	☒	☐	☒	☐	☒
Other Severe Weather	☒	☐	☒	☐	☒	☐	☒	☐	☒
Other	☐	☐	☐	☐	☐	☐	☐	☐	☐

Legend:

§201.6(c)(2)(i) Profiling Hazards
A. Does the risk assessment identify the location (*i.e.*, geographic area affected) of each hazard addressed in the **new or updated** plan?
B. Does the risk assessment identify the extent (*i.e.*, magnitude or severity) of each hazard addressed in the **new or updated** plan?
C. Does the plan provide information on previous occurrences of each natural hazard addressed in the **new or updated** plan?
D. Does the plan include the probability of future events (*i.e.*, chance of occurrence) for each hazard addressed in the plan?

CITY OF PORTLAND UPDATE, LOCAL MITIGATION PLAN REVIEW CROSSWALK

MATRIX B: ASSESSING VULNERABILITY

This matrix can assist FEMA and the State in scoring each hazard. Local jurisdictions may find the matrix useful to ensure that the new or updated plan addresses each requirement. **Completing the matrix is not required**.

*Note: First, check which hazards are identified in requirement §201.6(c)(2)(i). Then, place a checkmark in either the N or S box for each **applicable** hazard. An "N" for any element of any identified hazard will result in a "Needs Improvement" score for this requirement. List the hazard and its related shortcoming in the comments section of the Plan Review Crosswalk. Note: Receiving an N in the shaded columns will not preclude the plan from passing.*

Hazard Type	Hazards Identified Per Requirement §201.6(c)(2)(i)	§201.6(c)(2)(ii) Assessing Vulnerability: Overview					§201.6(c)(2)(ii) Assessing Vulnerability: Identifying Structures				§201.6(c)(2)(ii) Assessing Vulnerability: Estimating Potential Losses			
		A. Overall Summary Description of Vulnerability		B. Hazard Impact			A. Types and Number of Existing Structures in Hazard Area (Estimate)		B. Types and Number of Future Structures in Hazard Area (Estimate)		A. Loss Estimate		B. Methodology	
	Yes	N	S	N	S		N	S	N	S	N	S	N	S
Avalanche	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐
Coastal Erosion	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐
Coastal Storm	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐
Dam Failure	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐
Drought	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐
Earthquake	☒	☐	☒	☐	☒		☐	☒	☐	☒	☐	☒	☐	☒
Expansive Soils	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐
Levee Failure	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐
Flood	☒	☐	☒	☐	☒		☐	☒	☐	☒	☐	☒	☐	☒
Hailstorm	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐
Hurricane	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐
Land Subsidence	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐
Landslide	☒	☐	☒	☐	☒		☐	☒	☐	☒	☐	☒	☐	☒
Severe Winter Storm	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐
Tornado	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐
Tsunami	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐
Volcano	☒	☐	☒	☐	☒		☐	☒	☐	☒	☐	☒	☐	☒
Wildfire	☒	☐	☒	☐	☒		☐	☒	☐	☒	☐	☒	☐	☒
Windstorm	☐	☐	☐	☐	☐		☐	☐	☐	☐	☐	☐	☐	☐
Other Erosion	☒	☐	☒	☐	☒		☐	☒	☐	☒	☐	☒	☐	☒
Other Invasive Plants	☒	☐	☒	☐	☒		☐	☒	☐	☒	☐	☒	☐	☒
Other Weather	☒	☐	☒	☐	☒		☐	☒	☐	☒	☐	☒	☐	☒

Legend:

§201.6(c)(2)(ii) Assessing Vulnerability: Overview

A. Does the **new or updated** plan include an overall summary description of the jurisdiction's vulnerability to each hazard?

B. Does the **new or updated** plan address the impact of each hazard on the jurisdiction?

§201.6(c)(2)(ii)(A) Assessing Vulnerability: Identifying Structures

A. Does the **new or updated** plan describe vulnerability in terms of the types and numbers of existing buildings, infrastructure, and critical facilities located in the identified hazard areas?

B. Does the **new or updated** plan describe vulnerability in terms of the types and numbers of future buildings, infrastructure, and critical facilities located in the identified hazard areas?

§201.6(c)(2)(ii)(B) Assessing Vulnerability: Estimating Potential Losses

A. Does the **new or updated** plan estimate potential dollar losses to vulnerable structures?

B. Does the **new or updated** plan describe the methodology used to prepare the estimate?

CITY OF PORTLAND UPDATE, LOCAL MITIGATION PLAN REVIEW CROSSWALK

MATRIX C: IDENTIFICATION AND ANALYSIS OF MITIGATION ACTIONS

This matrix can assist FEMA and the State in scoring each hazard. Local jurisdictions may find the matrix useful to ensure consideration of a range of actions for each hazard. **Completing the matrix is not required.**

Note: First, check which hazards are identified in requirement §201.6(c)(2)(i). Then, place a checkmark in either the N or S box for each ***applicable*** *hazard. An "N" for any identified hazard will result in a "Needs Improvement" score for this requirement. List the hazard and its related shortcoming in the comments section of the Plan Review Crosswalk.*

Hazard Type	Hazards Identified Per Requirement §201.6(c)(2)(i)	A. Comprehensive Range of Actions and Projects	
	Yes	N	S
Avalanche	☐	☐	☐
Coastal Erosion	☐	☐	☐
Coastal Storm	☐	☐	☐
Dam Failure	☐	☐	☐
Drought	☐	☐	☐
Earthquake	☒	☐	☒
Expansive Soils	☐	☐	☐
Levee Failure	☐	☐	☐
Flood	☒	☐	☒
Hailstorm	☐	☐	☐
Hurricane	☐	☐	☐
Land Subsidence	☐	☐	☐
Landslide	☒	☐	☒
Severe Winter Storm	☐	☐	☐
Tornado	☐	☐	☐
Tsunami	☐	☐	☐
Volcano	☒	☐	☒
Wildfire	☒	☐	☒
Windstorm	☐	☐	☐
Other Erosion	☒	☐	☒
Other Invasive Plants	☒	☐	☒
Other Weather	☒	☐	☒

Legend:
§201.6(c)(3)(ii) Identification and Analysis of Mitigation Actions
A. Does the **new or updated** plan identify and analyze a comprehensive range of specific mitigation actions and projects for each hazard?

DMA 2000 Requirements – Prerequisites

Requirement §201.6(c)(5): The local hazard mitigation plan shall include documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan (e.g., City Council, Commissioner, Tribal Council).Adoption by Local Governing Bodies and Supporting Documentation

The requirements for NHMP local governing body adoption, as stipulated in the DMA 2000 and its implementing regulations are described below.

The Portland City Council is responsible for adopting the City NHMP via resolution and providing the support necessary to ensure implementation. Upon approval and recommendation by federal and state offices of emergency management the NHMP will be presented to City council for adoption by resolution.

The City Council adopted the NHMP by resolution on _____.

C.1 CITY CAPABILITY ASSESSMENT

DMA 2000 Requirements – Planning Process

Requirement §201.6(b): An open public involvement process is essential to the development of an effective plan.

Requirement §201.6(c)(1): [The plan shall document] 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.

This section provides an overview of the planning process; identifies the Planning Team Members and subject matter experts; documents public outreach efforts; and summarizes the review and incorporation of existing plans, studies and reports used to develop this NHMP. Additional information regarding public outreach efforts is provided in Appendix D.

C.2 OVERVIEW OF PLANNING PROCESS

2010 Plan Update

The 2010 City of Portland Natural Hazard Mitigation Plan update includes newly identified hazards. It provides a comprehensive risk assessment and vulnerability analysis, provides community based mitigation actions and identifies funding sources as part of the update. The first step in the planning process was to ensure that the Planning Team was comprised of subject matter experts from throughout the City. Patty Rueter, POEM Planning Manager, served as the primary point of contact for the overall plan's update and development.

The following seven-step planning update process took place from June through December 2009.

- **Preliminary Research:** Portland State University student interns pursuing Master degree programs in geology or urban studies researched plans, other city or county mitigation action items and the status of existing 2004 NHMP action items to provide background documents for the planning team and contractor involved in the update process.
- **Organize Resources:** POEM identified resources, including City staff, departments and agencies and local non-governmental organization (NGOs) and interns, which could provide the technical expertise, historical information and research data to update the existing NHMP.
- **Update Hazard Profiles:** Planning Team Members reviewed the hazards identified in the 2004 NHMP and assessed other hazards specific to the City. A hazard analysis was developed for eight hazards based on the types of hazards that have historically impacted the City.

- **Update Risk Assessment:** Planning Team Members reviewed the existing 2006 vulnerability analysis and used the results during mitigation strategy development.
- **Assess Capabilities:** Planning Team Members reviewed and determined whether the current administrative and technical, legal and regulatory and fiscal capabilities adequately addressed existing provisions and requirements and relevant hazards.
- **Update Mitigation Strategy:** Planning Team Members reviewed the existing mitigation goals and actions to determine if they still met the needs of the City as well as to determine whether actions had been implemented, were in progress, or were no longer applicable. Based on the results of the updated risk assessment, the Planning Team evaluated and prioritized the actions for implementation into the City's Mitigation Action Plan.
- **Monitor Progress:** Planning Team Members developed an implementation process to ensure the success of an ongoing program to minimize hazard impacts to the City.

C-Table C-2a 2010 NHMP Review and Update Summary

2004 NHMP Section	2004 Items to be Updated	2004 Items to be Deleted	2010 Items to be Added
Planning Process	• Planning process • Planning team • List of sources • Public outreach	N/A	N/A
Risk Assessment	• Hazard profile history • Asset inventory • Vulnerability analysis & summaries	N/A	New hazards Repetitive Loss properties NFIP requirements
Mitigation Strategy	• Mitigation actions status • Mitigation action implementation	Implemented & non-relevant mitigation actions	New mitigation actions Capability assessment
Plan Maintenance	• Plan maintenance process	N/A	Appendix F

Hazard 2010 NHMP Planning Team

The 2010 Planning Team members were selected based on their program involvement, expertise and decision making authority. The planning team consisted of subject matter experts who understand the hazards which could potentially impact the City. Project managers that include concerns related to the hazards of earthquake, wildland urban interface fire, severe weather, landslide, erosion, invasive plant species and volcano were recruited from the bureaus of Fire & Rescue, Parks & Recreation, Planning and Sustainability, Environmental Services, Development Services, Transportation and Water. Outreach to Portland State University Masters program for research interns and expertise of PSU Department of Geology, subject matter experts from the National Weather Service, Department of Geology and Mineral Industries and the Climate Change Research Institute lent review and accuracy to the background information of the report. URS Corporation contractors reviewed the plan to assure compliance to national standards.

This section outlines the resources available to the City for mitigation and mitigation related funding and training. All City regulatory tools and plans will continue to incorporate NHMP initiatives and activities throughout the planning cycle

C.2.1 Public Involvement

Table C-2-1a lists the City's public involvement focused to encourage participation, insight and data collection for the NHMP effort. Although the City requirements for public involvement were not met through this process they met the federal compliance standards. Time and personnel constraints prohibited public meetings during the preliminary, contracted update period of June to December but prior to update each program involved in mitigation activities conducted their own public involvement processes. For example the Wildland Urban Interface Fuel Reduction program conducted public involvement accentuated the education of the public and its participation in mitigating wildland fires.

The first phase of the 2010 update was the review of existing action items and update/compilation of all bureaus mitigation strategies. The second phase will be DMA 2000 compliance approval and recommendation by the federal and state offices of emergency management, followed by the third phase when the public reviews, prioritizes, improves and approves the final document before taking it to council.

Table C-2-1a Public Involvement Mechanisms – During Plan Development

Mechanism (Plan Development)	Description
Advertised through Portland State University Masters Program of Urban Planning and the Department of Geology.	Four interns answered the request and worked through their summer vacation in the Portland Office of Emergency Management updating actions, interviewing 2004 committee members and researching hazards.
Subject Matter Experts consulted on accuracy of hazard information.	Department of Geology and Mineral Industries consulted on landslides and earthquake hazards. Climate Change Research Institute advised on the impacts on climate change on flooding, landslides and severe weather and the National Weather Service advised on weather trends.
Website NHMP Update Process Notice, September 30,2009	Posted the newsletter on the City's website soliciting involvement and input. *http://www.portlandonline.com/oem/index.cfm?c=36870&a=267385*
Presented to City Council	Addressed council to accept FEMA Pre-Disaster Mitigation Grant funds and announce the update of the plan to point out mitigation activities that the City is implementing and the update process. Council is filmed for public viewing on Cable Network.
Provided existing Plans, September 2009	Promoted mitigation actions inclusion in developing plans of city bureaus such as review of Comprehensive Plan, River Renaissance, Sellwood Bridge reconstruction, 08 & 09 City Assets Management Report, Riverfront Park design and 09 Climate Action Plan; Watershed Mgmt Plan and Forest Park Natural Resources Management Plan.
Presented at Citywide workshops, September to December 2009	Bureau of Planning and Sustainability annual Fix-It Fair; NW Industrial Neighborhood meetings; Water Bureau Emergency Management brown-bag luncheon series; Annual PBOT Winter readiness meetings.

On September 30, 2009, POEM intended to post a public notice and newsletter on their website describing the 2009 NHMP update process. The website was meant to be a medium used to extend an invitation to all individuals and entities to review the existing plan through an online survey. Unfortunately the web restructuring at the time of posting interfered with the viewing and review of the plan. The 2004 NHMP has been posted on the POEM website for comment since its publication www.portlandonline.com/oem.

The Planning Team gathered and processed hazard impact and profile information. The participants defined potential hazards for further evaluation (erosion, volcano and invasive plants and also chose to further expand the weather hazard with adding discussions concerning climate change, drought, El Niño/La Niña Southern Oscillation [ENSO], high temperature, straight line wind and tornado).
The Planning Team further processed data from respondents identifying critical facilities in the community to complete the risk assessment including the location, value and population of residents and critical facilities in the community.

The Planning Team collected community asset data during the summer and fall of 2009. This information facilitated the risk assessment's completion, which illustrates exposed and vulnerable assets to specific hazards.

A second newsletter was provided on November 9, 2009 describing the process to date, presenting the prioritized mitigation actions and announcing the availability of the draft NHMP for public review and comment.

Prior to acceptance by council and as a part of the Citizen Mitigation Action Plan, the NHMP will be posted on our new improved website and education regarding the opportunity to comment will be publicized.

C.2.2 Planning Team Meetings and Tasks

October 1, 2009, Planning Team Meeting #1

During the kickoff meeting the attendees discussed the project objective and the requirements for federal compliance. The City assisted in identifying information gaps to focus the Planning Team's efforts. The gaps included:

- New Hazard Identification and Updated Hazard History Data
- Repetitive Loss Data
- Vulnerability Data
- Capability Assessment Data

The process included reviewing the existing Portland NHMP to familiarize members with its approach and concepts used during initial risk identification development. Eight hazards were determined to pose the greatest potential risk to the city. Those include earthquake, erosion, flood, invasive plant species, landslide, volcano, severe weather and wildland urban interface fire. They then reviewed the City's 2004 mitigation goals and mitigation activities and discussed how to update them to best create a disaster resilient city. The team decided to update the listed goals as reflected in the updated mitigation strategy.

October 12, 2009, Planning Team Meeting #2

Participants met to review the existing NHMP mitigation goals, existing hazard mitigation actions list to determine their status, consider action editing concerns and identify newly identified potential mitigation actions to implement during the next five-year planning cycle.

Participants then worked to update the existing hazard profiles and assimilate new research data and mapping projects to update the NHMP. Participants discussed preliminary results of the risk assessment, preliminary city-specific vulnerability analyses and asset information (critical facilities and infrastructure, population and residential and nonresidential structures).

As a result of Meeting #2 the Planning Team reviewed and updated the 2004 implemented hazard mitigation actions and selected new actions for further consideration based on the results of the risk assessment.

Participants determined to carry forward the deferred and ongoing mitigation actions from the 2004 NHMP.

Planning Team Tasks October to November, 2009

Planning team members reviewed hazard-specific narratives and conferred with their bureaus and subject matter experts.

After the Planning Team members reviewed the simplified Social, Technical, Administrative, Political, Legal, Economic and Environmental (STAPLEE) evaluation criteria, the Planning Team decided their membership has sufficient experience, historical knowledge and resources to select and rank the City's mitigation activities. Section 7.6 contains a narrative explaining this process.

November 23, 2009, Planning Team Meeting #3

The November meeting was held to present key findings. Planning Team members are to develop short presentations outlining their NHMP success and newly identified mitigation actions for the City Council. The Planning Team validated the ranked outcomes, approved the NHMP through consensus and approved it for Oregon Emergency Management (OEM) and FEMA submission after their final review. The Team agreed to meet in March and provided recommendations on key collaborative actions and their committee membership.

C.2.3 Incorporating Existing Plans and Other Relevant Information

One of the new goals of the 2010 NHMP, is "Cross reference NHMP goals and actions with all City plans, projects and programs investments." During the planning process, the Planning Team reviewed and incorporated information from existing plans, studies and technical reports into the NHMP. These resource references and reviews provided jurisdiction specific information for hazard profiles, risk assessment and vulnerability analysis development for the City's NHMP:

- City of Portland Comprehensive Plan, October 1980: defines land use, development and government processes.
- Climate Action Plan, 2009; Bureau of Planning and Sustainability defines the City's climate change initiatives.
- Economic Districts Atlas: identifies indoctrinated mitigation initiatives.
- Forest Park Natural Resource Management Plan, 1995: defined current information on natural resources in Forest Park and developed a set of goals and actions designed to guide management of natural resources and recreational uses.
- City of Portland Code Development: defines land use and development, building code compliance and bureau responsibilities. This is the zoning code (Portland City Code Title 33) and Building Regulations (Title 24).

- Portland Wildfire Fuel Reduction Project (FEMA NHMP)
  Website:<www.portlandonline.com/wildfire>
- Portland Wildfire Readiness Assessment & Gap Analysis Report, 2009: defined actions to improve the City's wildfire coordination, training and mitigation.
- Citywide Assets Report, December 2008: provides physical asset and critical facility information.
- Portland Standard Construction Specifications, 2007: defines building code compliance.
- Portland Water Bureau Requested Five-Year Capitol Improvement Program, 2007-2012: identified infrastructure mitigation efforts.
- Portland Bureau of Planning Strategic Work Plan, 2006-2010: defined the City's ongoing projects and strategy for completion.
- Portland Bureau of Planning Work Plan-Ongoing Projects, November 2008: defined the City's ongoing projects and completion timeline.
- Portland Urban Forestry Management Plan, 2004: defined improvements and coordination needed for managing and administering Portland's urban forest.
- Mt. Hood Coordination Plan, 2005: defined the City's participation within the coordination group and Mt Hood's volcanic activity and threat to the City of Portland.
- Critical Infrastructure Protection Plan, Portland/Vancouver Urban Area; August 2007, defined the City's critical infrastructure.

Actions from some of the above plans were incorporated as action items in the 2010 NHMP. Some plans were referenced for language consistency, data and gap analysis and background information on city descriptions. A complete list of references consulted for the NHMP update is provided in Appendix H.

C.3 PLANNING REQUIREMENTS

C.3.1 Local Mitigation Plans

In recent years, new Federal law redefined local hazard mitigation plan development. On October 30, 2000, Congress passed the Disaster Mitigation Act of 2000 (DMA 2000) (Public Law [PL] 106-390) which amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) (Title 42 of the United States Code [USC] 5121 et seq.) by repealing the Stafford Act's Section 409 mitigation planning requirement and replacing it with Section 322, which defined Federal Emergency Management Agency's (FEMA) new mitigation planning requirements. Section 322 emphasizes the need for State, tribal and local entities to closely coordinate mitigation plan development and implementation efforts. In addition, it provides the legal basis for the FEMA mitigation plan requirements for access to mitigation grant assistance.

FEMA published its Interim Final Rule in the Federal Register on February 26, 2002, 44 CFR Part 201 (FEMA 2002) with subsequent updates to implement these planning requirements. The planning requirements for local entities are described in detail in Section 2 and are identified in their appropriate sections throughout this Natural Hazard Mitigation Plan (NHMP).

On October 31, 2007, FEMA changed 44 CFR Part 201.6 by combining and expanding local hazard mitigation plans with flood mitigation plans. This change defined that participating NFIP communities' need to include risk assessments and mitigation strategies that identify and address repetitively flood damaged properties. The newly defined plan requirements eliminated duplicated requirements and grant qualification for all Unified Hazard Mitigation Assistance (UHMA) programs:

- Hazard Mitigation Grant Program (HMGP)
- Pre-Disaster Mitigation (PDM)
- Flood Mitigation Assistance (FMA)
- Severe Repetitive Loss (SRL)
- Repetitive Flood Claim (RFC) programs.

The HMGP remains as a separate state managed, direct disaster funded mitigation assistance program.

Table C-3-1a City Regulatory Tools and Plans

Regulatory Tools (ordinances, codes, plans)	Comments (year of most recent update; problems administering it, etc)
City Charter	http://www.portlandonline.com/auditor/index.cfm?c=28148
Comprehensive Plan	Completed in 2007: http://www.portlandonline.com/bps/index.cfm?c=34249
City Policy Documents	http://www.portlandonline.com/auditor/index.cfm?c=26812
City Building Codes	Chapter 24: http://www.portlandonline.com/auditor/index.cfm?c=28188
Floodplain ordinances	Chapter 24.50
Seismic Ordinances	Chapter 24.85
Wildfire Code	Chapter 24.51
Multnomah County Ordinances	http://www2.co.multnomah.or.us/counsel/code/index.shtml
Economic Development Plan	http://www.pdxeconomicdevelopment.com/docs/Portland-Ec-Dev-Strategy.pdf
Emergency Response Plan	http://www.portlandonline.com/auditor/index.cfm?&a=102348&c=47407
Wildfire Protection Plan	http://www.portlandonline.com/Auditor/index.cfm?a=226988&c=28414 City Code 3.22.180 Forested and Wildland Interface Areas Fire Protection Plan
Portland Urban Forestry Management Plan, 2004	http://www.portlandonline.com/parks/index.cfm?a=184641&c=38306
Comprehensive Plan Work Plan	http://www.portlandonline.com/bps/index.cfm?c=45460&a=218764

(Portland 2008, Portland 2009b)

C.3.2 Mitigation Plan Requirements for FEMA Grant Programs

The new 2008 44 CFR update changed governing mitigation planning requirements for local mitigation plans published under §201.6. Local mitigation plans now qualify communities for the disaster funded HMGP and the combined Hazard Mitigation Assistance (HMA) Grants: PDM, FMA and SRL.

FEMA policy may require a local mitigation plan under the RFC Program, at which time this policy will apply to those governments that apply for and/or receive assistance under this program as well.

As of June 19, 2008, the grant programs were segregated into post- and pre-disaster programs. The HMGP is a state managed, directly funded, competitive post-disaster grant program. Whereas the newly formed HMA programs: PDM, FMA, SRL and potentially RFC are pre-disaster programs that are nationally competitive and rely on specific grant funding sources. These pre-disaster grants share several common elements.

> *"The [United States] Department of Homeland Security (DHS) FEMA Hazard [HMA] grant programs present a critical opportunity to protect individuals and property from natural hazards while simultaneously reducing reliance on Federal disaster funds. The HMA programs provide PDM grants annually to States, Territories, Tribes and local communities. The statutory origins of the programs differ, but all share the common goal of reducing the loss of life and property due to natural hazards.*
>
> *The PDM program focuses on mitigation project and planning activities that address multiple natural hazards, although these activities may also address hazards caused by manmade events. The [FMA, SRL and RFC programs] are authorized by the National Flood Insurance Act and focus on reducing claims against the National Flood Insurance Program." (FEMA 2006b)*

C.3.2.1 Disaster Funded Mitigation Assistance – Section 404

The HMGP (Stafford Act §404) provides grants to States, Tribes and local entities to implement long-term hazard mitigation measures after a major disaster declaration. The HMGP focuses on repetitive damages from past disasters. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster and not be associated with disaster damages impacting public infrastructure.

This program is administered by the State and funded by FEMA. Projects must provide a long-term solution to a problem, for example, elevating a home to reduce the risk of flood damages as opposed to buying sandbags and pumps to fight the flood. In addition, a project's potential savings must be more than the cost of implementing the project. Funds may be used to protect either public or private property or to purchase property that has been subjected to, or is in

danger of, repetitive damage. The amount of funding available for the HMGP under a particular disaster declaration is limited. FEMA may provide a State or Tribe with up to 20 percent of the total aggregate disaster damage costs to fund HMGP project or planning grants. The cost-share for this grant is 75 percent Federal/25 percent non-Federal.

C.3.2.2 Dis aster Funded Mitigation Assistance – Section 406

Public Assistance-funded mitigation opportunities exist within FEMA's Public Assistance Program under Stafford Act §406 mitigation. This activity provides a mechanism for implementing mitigation measures when rebuilding disaster-damaged public infrastructure, to provide long-term recovery and to mitigate future disaster damage impacts.

Disaster Assistance Policy 9526.1 provides guidance for using this discretionary hazard mitigation funding opportunity under the Stafford Act, §406 and 44 CFR §206.226. The Policy states:

A. Section 406 provides discretionary authority to fund mitigation measures in conjunction with the repair of the disaster-damaged facilities. These opportunities usually present themselves during the repair efforts. The mitigation measures must be related to eligible disaster-related damages and must directly reduce the potential of future, similar disaster damages to the eligible facility. This work is performed on the parts of the facility that were actually damaged by the disaster and the mitigation measure provides protection from subsequent events. Exceptions to this provision will be reviewed on a case-by-case basis.

B. Mitigation measures must be determined to be cost-effective. Any one of the following means may be used to determine cost-effectiveness:

   1. Mitigation measures may amount to up to 15 percent of the total eligible cost of the eligible repair work on a particular project.

   2. Certain mitigation measures (see Appendix A) determined cost-effective, as long as the mitigation measure does not exceed 100 percent of the eligible cost of the eligible repair work on the project.

   3. For measures that exceed the above costs, the Grantee or subgrantee must demonstrate through an acceptable benefit/cost analysis methodology that the measure is cost-effective. FEMA's Benefit Cost Analysis (BCA) software provides appropriate benefit/cost analysis methodologies. You can obtain the software from FEMA by contacting the BCA helpline at 1-866-222-3580, e-mail (bchelpline@dhs.gov), or the applicable FEMA Regional Office (FEMA 2007).

C.3.2.3 Unified Hazard Mitigation Assistance (UHMA) Programs

The PDM Grant Program provides funds to State, Tribes and local entities, including universities, for hazard mitigation planning and mitigation project implementation prior to a disaster event. PDM Grants are awarded on a nationally competitive basis. Like HMGP funding, a PDM project's potential savings must be more than the cost of implementing the project. In addition, funds may be used to protect either public or private property or to purchase property that has been subjected to, or is in danger of, repetitive damage. The total amount of PDM funding available is appropriated by Congress on an annual basis. In Fiscal Year (FY) 2008, PDM program funding totaled approximately $54 million. The cost-share for this grant is 75 percent Federal/25 percent non-Federal.

The City of Portland has been a NFIP program participant since 1975, has a current Flood Insurance Rate Map (FIRM) (2004) and participates in the Community Rating System (CRS) program maintaining a five (5) rating since 2007.

NFIP participation fulfills eligibility requirements for National Flood Insurance Act grant program grants. The City's exceptional CRS five (5) rating qualifies the community for a 25% insurance rate reduction.

The goal of the FMA grant program is to reduce or eliminate flood insurance claims under the National Flood Insurance Program (NFIP). Particular emphasis for this program is placed on mitigating repetitive loss (RL) properties. The primary source of funding for this program is the National Flood Insurance Fund. Grant funding is available for three types of grants, including Planning, Project and Technical Assistance. Project grants, which use the majority of the program's total funding, are awarded to States, Tribes and local entities to apply mitigation measures to reduce flood losses to properties insured under the NFIP. In FY 2008, FMA funding totaled $32 million. The cost-share for this grant is 75 percent Federal/25 percent non-Federal. However, 90 percent Federal/10 percent non-Federal to mitigate SRL properties is available in certain situations.

The SRL program provides funding to reduce or eliminate the long-term risk of flood damage to residential structures insured under the NFIP. Structures considered for mitigation must have at least four NFIP claim payments over $5,000 each, when at least two such claims have occurred within any 10-year period and the cumulative amount of such claim payments exceeds $20,000; or for which at least two separate claim payments have been made with the cumulative amount of the building portion of such claims exceeding the value of the property, when two such claims have occurred within any 10-year period. Congress authorized $40 million for FY 2006 and FY 2007, $80 million for FY 2008 and $80 million for FY 2009. The cost-share for this grant is 75 percent Federal/25 percent non-Federal. However, 90 percent Federal/10 percent non-Federal to mitigate SRL properties is available when the State or Tribal plan addresses ways to mitigate SRL properties.

The RFC program provides funding to reduce or eliminate the long-term flood damage risk to residential and nonresidential structures insured under the NFIP. Up to $10 million is available annually to assist States and communities with reducing flood damages to structures that have

had one or more claim payments for flood damages. All RFC grants are eligible for up to 100 percent Federal assistance.

C.4 IDENTIFYING MITIGATION ACTIONS

Mitigation actions are activities, measures, or projects that help achieve the goals of a mitigation plan. Mitigation actions are usually grouped into broad categories: prevention, property protection, public education and awareness and structural projects. In the City's NHMP, the action items are listed by hazard and those that address many hazards through the implementation of the action item are listed under the Multi-Hazard (MH) category.

The 2004 NHMP listed 96 mitigation action items selected for implementation for the five-year planning cycle. On October 2, 2009, the Planning Team reviewed the existing action's status and found eight action items completed, 11 completed the action item of the 2004 plan and were determined to have next steps that kept them in an "completed but ongoing" category and 48 were classified as ongoing.

Portland's 2010 NHMP identified an additional 61 new "to be considered" action items. Many items were combined for greater applicability to all hazards. Some combined many individual bureau actions into one action that would allow greater collaboration and resource sharing. Some were deferred to a later date or deleted because of change in program priorities within the responsible bureau.

The Planning Team placed particular emphasis on projects and programs that support the 2009 NHMP goals; reduce the impacts of multiple hazards; that address infrastructure, the built environment (both new and existing) and actions that assure the City maintains NFIP compliance and apply to Emergency Management Accreditation Program standards.

The following table lists all of the actions from the 2004 plan and the proposed actions for inclusion in the 2010 action plan. They are listed by hazard in alphabetical order starting with the actions that address Multiple Hazards (MH) followed by Earthquake (EQ), Erosion (ER), Flood (FlL, Invasive Species (IS), Severe Weather(SW), Volcano (V) and Wildland Urban Interface Fire(WF). All actions are listed so the bureau proposed actions would not be lost through discussion, revisions and combinations.

The first column lists the identification number of the action item as short term (ST) – having the resources and prioritization to be implemented and completed within five years or sooner and long term (LT) which need additional time or resources to complete to complete.

The third column is sometimes an inconclusive list of Coordinating Organization/ Internal Partners.

Under the Status/Comments section, bureaus identified if actions were:

Completed – action item had been finished in the last 5 years

Completed and Ongoing – the 2004 action item was completed but next steps on the project were identified

To be considered - ideas that might be used in other cities that have not been determined as a part of a City project

New and selected to implement – included in the City 2010 NHMP

Implement – shows that some actions are combined with other actions and which action they are combined with – this is shown by the ID# included in the column

Deferred or Deleted – actions that are not priorities of the responsible bureau and their implementation is delayed or are either removed from the action plan

Table C-4a Mitigation Goals and Full List of Action Items (2004 action items and 2010 proposed action items, status and alignment with 2010 goals)

Actions					2010 Goals						
ID	Description	Coordinating Organizations/ Internal Partners	Status: Complete, Deferred, Deleted, Ongoing, or New - Consider or Selected to Implement	Status / Comments	1. Update risk and vulnerability analysis every five years	2. Implement actions to protect life, property and natural systems	3. Promote public outreach to diverse populations	4. Improve City of Portland's economic resilience by identifying mitigation action successes.	5. Commit to continuously reducing the City's natural hazards vulnerability.	6. Cross reference NHMP goals and actions with all City plans, projects and program investments.	7. Coordinate mitigation activities with regional communities and agencies.
MULTI-HAZARD (MH)											
ST MH #1	Continue to involve the public in updating the Natural Hazard Mitigation Plan	Portland Office of Emergency Management (POEM), Bureau of Planning and Sustainability, Office of Neighborhoods	Ongoing		X	X	X	X	X	X	X
ST MH #2	Form a committee to identify and coordinate critical transportation (street and highway) networks	Portland Department of Transportation (PBOT)/ Bureaus of Planning and Sustainability, Fire & Rescue, Police, Parks and Recreation, Urban Forestry	Complete and Ongoing	Map included in Earthquake section Transportation routes defined for EQ debris clearing, snow and ice removal and mass transit routes			X	X		X	X
ST MH #3	Revise Portland's Comprehensive Plan to address natural hazards including, but not limited to, floods, landslides, earthquakes, wildfires and winter storms	Bureau of Planning and Sustainability/ POEM	Ongoing	Similar to action in LT MH #1		X		X	X	X	
ST MH #5	Acquire Light Detection and Ranging (LiDAR) images of the Portland Metro area and the Bull Run Watershed	POEM / Corporate GIS, Bureau Environmental Services, (BES) Fire and Rescue, Bureau of Water, PBOT, Bureau of Planning & Sustainability(BPS)	Ongoing	Bull Run Watershed has been analyzed but not the entire City Combined all LiDAR Activities under MH	X X	X	X	X	X	X	X
ST MH #6	Use findings from Portland's Risk Assessment (HAZUS-MH) to enhance the existing debris removal plan	Bureau of Planning and Sustainability / POEM, PBOT, BES	Ongoing		X			X			X
ST MH #7	Create a mitigation mapping committee	POEM, Corporate GIS / BES, PBOT, Bureau of Development Services (BDS), Fire Bureau, Bureau of Water Bureau, Bureau of Planning and Sustainability	Ongoing	Maps library has 72+ map layers identified, need to include input from all bureau GIS mapping	X	X				X	
ST MH #8	Partner with utilities as they ensure continuity of service to the City	PPOEM/Disaster Policy Council (DPC), Mitigation Sub-Committee leaders; Cable and Franchise	Ongoing	Collaborating with public utilities to develop a prioritization process	X		X	X		X	X
ST MH #9	Develop a city employee emergency response plan to assure that city employees know what is expected of them so that services are continued	POEM / DPC Human Resources, OMF, Bureau of General Services (BGS), Fire and Rescue, Police, Emergency Communications	Complete and Ongoing	Purchased emergency kits, created floor warden procedures and developed building emergency plans developed multi-level training programs			X		X	X	
ST MH #10	Develop educational materials (television and print media) for residents that identify and define their risk to multi hazards: define and offer mitigation measures residents can take. Determine method of distribution of the educational materials	POEM	Ongoing Implement LTMH#2	Reworded to incorporate all outreach activities		X	X		X	X	
ST MH #11	Implement actions in the 2005 Portland Watershed Management Plan (PWMP) to help mitigate flood, landslide, earthquake and wildfire hazards	BES	Ongoing			X		X	X	X	X
ST MH #	Develop and maintain GIS mapped inventory and develop prioritized list of critical facilities and residential and commercial buildings within 100-year and 500-year floodplains (NFIP Compliance)	POEM, Corporate GIS / BES, PBOT, BDS, Fire Bureau, Bureau of Water, Bureau of Planning and Sustainability	Ongoing		X	X				X	
LT MH #2	Develop a public outreach program to raise awareness of hazard risk	POEM / Bureau of Planning & Sustainability, DPC NETs, Bureau of Sustainable Development, BDS, BES, Bureau of Water, Parks and Recreation, Office of Neighborhood Involvement, PBOT,	DELETED	Combined all outreach activities under Multi-Hazard Section							

Table C-4a Mitigation Goals and Full List of Action Items (2004 action items and 2010 proposed action items, status and alignment with 2010 goals)

Actions					2010 Goals						
ID	Description	Coordinating Organizations/ Internal Partners	Status: Complete, Deferred, Deleted, Ongoing, or New - Consider or Selected to Implement	Status / Comments	1. Update risk and vulnerability analysis every five years	2. Implement actions to protect life, property and natural systems	3. Promote public outreach to diverse populations	4. Improve City of Portland's economic resilience by identifying mitigation action successes.	5. Commit to continuously reducing the City's natural hazards vulnerability.	6. Cross reference NHMP goals and actions with all City plans, projects and program investments.	7. Coordinate mitigation activities with regional communities and agencies.
LT MH #3	Increase the responsiveness of the emergency permitting procedures for post-hazard event periods through development of a procedural plan and the purchase of a mobile permitting van.	BDS /PBOT, BES, Bureau of Water, Risk Management	Ongoing	The City will address hazards as part of state-mandated Comprehensive Plan Review for 2012				X			X
LT MH #4	Develop citywide vegetation protection/ planning goals, policies and plans and implementing tools. Coordinate with vegetation management strategy development for wildfire, flood and landslide hazard mitigation	Bureau of Planning & Sustainability, BES / BDS, Parks and Recreation; Fire & Rescue	Complete	Portland Watershed Management Plan 10 2006-07 Annual Report	X						
LT MH #5	Coordinate emergency standard operating procedures and plans between disaster responder organizations in the Portland metro region and TriMet, to coordinate and expedite decision-making during emergencies	POEM, PBOT, Bureau of Fire & Rescue, BOEC,	Ongoing			X	X	X	X	X	X
LT MH #6	Promote the development of TriMet communications and dispatch capability to immediately implement changes to transit routes and service due to disruption of streets, roads, bridges and lt. rail transit tracks	PBOT, BOEC	Ongoing				X	X			X
New LT MH #7	Develop a multiple-agency multi-hazard evacuation plan (EQ, flood, fire and landslide at a minimum)	POEM / PBOT	Ongoing	Combined all evacuation actions in MH		X	X			X	X
New LT MH #8	Review and amend City Code to require that all facilities that store or handle hazardous materials (including large tanks) and which are located in the 500-year floodplain or landslide hazard areas, develop a hazardous materials inventory statement. This statement will be made available for Fire Bureau review. Require that these storage tanks are either adequately protected or relocated outside of the 500 year floodplain (NFIP Compliance)	Fire Marshal / Fire Bureau, POEM, BDS, Planning & Sustainability (for mapping and potential code changes)	Ongoing	COMBINED ALL hazmat actions in MH	X	X			X	X	X
New LT MH #9	Identify and pursue funding opportunities from outside agencies to fund and implement identified mitigation projects	All bureaus	New – Implement	Combined all funding activities in MH. (will be an annual inter-bureau agenda item)					X		
New LT MH #10	Assess the stability of levees in the Columbia Corridor Area and develop appropriate emergency plans to address potential levee failure and associated hazards	POEM / Bureau of Water, Fire Bureau, BES	Complete and Ongoing	Levees in Pen 1, Pen 2, Multnomah County Drainage District (MCDD) recertified by the USACE and FEMA					X		X
New LT MH #11	Support development of a multiple-agency plan for Marine Drive closure coordination	POEM / Bureau of Water, PBOT	Complete and Ongoing.	Developed between police and PBOT with local businesses	X			X	X	X	X
New MH	Cross reference and incorporate mitigation planning provisions into all community planning processes such as comprehensive, capital improvement and land use plans, etc to demonstrate multi-benefit considerations and strengthen eligibility from multiple funding sources	POEM, Planning and Sustainability, Fire, PBOT, Bureau of Water, BES	New – Implement Ongoing	Planning efforts: (Linnton Hillside Plan, Environmental Code Improvement project), will incorporate complete during Comprehensive Plan Periodic Review update in late 2012	X X				X	X	X
New MH	Identify and list repetitively flooded structures and infrastructures, analyze the threat to these facilities and prioritize mitigation actions to protect the threatened population from all hazards (NFIP Compliance)	Planning and Sustainability, PBOT, BES, POEM; State Floodplain Manager	New – Implement Ongoing	Floodplain buy out through BES has successfully, lowered the # of RL properties	X	X	X		X	X	

Table C-4a Mitigation Goals and Full List of Action Items (2004 action items and 2010 proposed action items, status and alignment with 2010 goals)

Actions					2010 Goals						
ID	Description	Coordinating Organizations/ Internal Partners	Status: Complete, Deferred, Deleted, Ongoing, or New - Consider or Selected to Implement	Status / Comments	1. Update risk and vulnerability analysis every five years	2. Implement actions to protect life, property and natural systems	3. Promote public outreach to diverse populations	4. Improve City of Portland's economic resilience by identifying mitigation action successes.	5. Commit to continuously reducing the City's natural hazards vulnerability.	6. Cross reference NHMP goals and actions with all City plans, projects and program investments.	7. Coordinate mitigation activities with regional communities and agencies.
New Reworded MH	Acquire (buy-out), demolish, or relocate structures from hazard prone areas (earthquake, erosion, flood, landslide, volcano and wildfire). Property deeds shall be restricted for open space uses in perpetuity to keep people from rebuilding in hazard areas (NFIP compliance)	Planning and Sustainability, PBOT, BES, POEM; State Floodplain Manager, Bureau of General Services (BGS), Bureau of Parks and Recreation, BDS, BES, Risk Management	Complete and Ongoing	Combined all hazard references to acquisition/relocation/demolition projects Buy-out programs: BES Floodplain, Gray to Green program, 2006 Metro Bond Measure and Johnson Creek Willing Seller program 87.1 acres	X	X		X	X		
New MH	Review ordinances and develop outreach programs to assure propane tanks are properly anchored and hazardous materials are properly stored and protected from known natural hazards such as flood or seismic events	POEM, Fire, BDS,	New – Implement Ongoing			X	X		X	X	
New MH	Develop and incorporate building ordinances commensurate with building codes to reflect survivability from flood, fire, wind, seismic and other hazards to ensure occupant safety. (NFIP Compliance)	POEM, BDS, Bureau Planning & Sustainability	New – Implement Ongoing	Have all hazards reviewed for code related to critical facilities. Have language specific to upgrading redevelopment and guiding new development.; Undertake an inventory of the commercial, apartment/condominium bldgs within city limits built prior to 1992.					X	X	
New MH	Update the Infrastructure Master Plan and System Vulnerability Assessment	POEM, Planning and Sustainability, Bureau of Water, PBOT, BES, OMF, BDS, Bureau of Parks and Recreation, PDC	New – Implement	Rebuilding and maintaining the City's infrastructure includes Hazard and risk analysis criteria	XX				X	X	
New MH	Partner with PGE to develop a west side operations center to be used during an emergency if the east side becomes inoperable	Bureau of Water, BES, POEM	New - Consider	Important due to division of bridges, facility mapping and vulnerabilities				X	X		
New MH	Promote 09 Climate Action Plan action items with similarities to adaptation planning and mitigation actions	POEM/Bureau of Planning and Sustainability	New – Implement	09 Climate Action Plan identification "Adaptation" as similar to "Mitigation". Identify shared actions	X	X			X	X	
MH	Partner with PGE to develop a secondary electrical feed to the Columbia South Shore Wellfield to provide for redundancy incase of primary power outage	Bureau of Water, BES, POEM	New – Implement		X	X			X	X	
EARTHQUAKE (EQ)											
ST-EQ#1	Using television and print media, educate the public about the importance of signs containing bridge identification information during an earthquake	PBOT	DELETED	Combined all outreach activities under MH							
ST-EQ#2	Assess existing earthquake related mitigation plans and vulnerability studies to identify areas of conflict, duplication or gaps	POEM / Fire Bureau, PBOT, BES, Bureau of Water, BDS Bureau of Planning and Sustainability	Ongoing	BDOT: EQ first response of 6.0 or greater. PF&R: Fire department disaster plan. Water Bureau: Section 4.2 EQ	X				X	X	
ST-EQ#3	Update the vulnerability analysis of Columbia Boulevard Wastewater Treatment Plant (CBWTP0 Tyron Creek Wastewater Treatment Plant (TCWTP) and wastewater pump stations	BES. PBOT	Partially Complete – Ongoing	Draft SVA for CBWTP Three SVA volumes for TCWTP No SVA Data Exists for the PS	X				X	X	
ST-EQ#4	Prioritize the return of power to treatment plants (Tryon Creek and Columbia Boulevard) and pump stations	BES / POEM	Partially Complete – Ongoing	CBWTP has two separate power feeds and limited generator power TCWTP has a back up generator system and automatic transfer switch (ATS)	X	X			X	X	
ST-EQ#5	Lobby to implement legislation of General Obligation Bonds to fund rehabilitation of critical structures	Governmental Relations / BDS, Portland Development Commission, POEM, PBOT, Parks and Recreation	Complete	Go bond task force, General Obligation Bonds passed, Funds out to fire/schools							

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St-EQ#6	Identify secondary hazards generated from earthquake-generated landslides and all other secondary implications	POEM	DELETED Changed to LT EQ #10	Multnomah County NHMP Addresses Landslides							
ST-EQ#7	Work with local jurisdictions to assess the capacity of landfill to accommodate earthquake debris: develop coordination plans for disposal of debris in the aftermath of an earthquake	POEM / PBOT, Bureau of Planning and Sustainability	DELETED Changed to LT EQ #11	Metro: Solid waste and recycling department; Emergency Response Plan; Multnomah county NHMP addresses debris removal							
ST-EQ#8	Study the feasibility of mandatory or voluntary installation of seismic shutoff valves on natural gas meters at commercial and residential buildings	Bureau of Fire / BDS, Bureau of Fire, POEM	Deferred	CREW recommends installation of shut off valves					X		
ST-EQ#9	Develop emergency evacuation plans for residential areas that are near significant hazardous materials storage facilities and heavy industrial areas	POEM	Moved to LT-MH#7	Combined with other emergency evacuation planning activities under MH							
ST-EQ#10	Revising seismic design requirement for existing buildings	BDS	Complete								
LT-EQ#1	Evaluate Funding Alternatives that might accelerate seismic retrofitting of the City's bridges	PBOT	DELETED	Combined funding activities under MH							
LT-EQ#2	Conduct a vulnerability analysis of Portland's sewer system to identify potential failure elements	BES /Corporate GIS, Portland PBOT, Fire Department, Police Department, POEM, Bureau of Water	Complete and Ongoing	BES has Consequence of failure maps	X			X			
LT-EQ#3	Develop a plan to strengthen sewer infrastructure in areas where street overlays and sewers have potential to collapse in a seismic event	PBOT /Corporate GIS; BES, Bureau of Water, POEM	Ongoing.	No specific seismic upgrade for pipes under roads BES has been strengthening pipes under roads, streetcar and light rail lines						X	
LT-EQ#4 BES	Develop a sewer failure response plan	BES / Corporate GIS, PBOT, BES, Bureau of Water	Deferred until 01/10.	BES will implement the Sanitary Sewer Release Response plan					X	X	
LT-EQ#5	Develop an educational program that targets homeowners, providing them with inexpensive methods that they can use to strengthen their homes against earthquake damage	POEM / BDS, Bureau of Water, Fire Department	DELETED	Combined all outreach activities under MH	X						
LT-EQ#6	Assess the vulnerability of the water distribution system to seismic events: work toward hardening the system	Bureau of Water	Deferred Ongoing	Deferred due to lack of funding and staff resources	X X				X	X	
LT-EQ#7	Partner with DOGAMI and USGS to obtain funding to complete EQ Fault mapping and improvement technology for data and information transfer	POEM	DELETED	Combined with ST #5 LiDAR Mapping is currently in progress							
LT-EQ#8	Study development regulations and policies to ascertain if regulations can be made to limit development of high risk facilities in known areas of earthquake hazards	POEM / BDS, Bureau of Planning and Sustainability, PBOT, Bureau of Fire	Ongoing	State law does not allow us to make building regulations more stringent than the State Code					X	X	
LT EQ#9	Assess the stability of levees in the Columbia Corridor Area and develop appropriate emergency plans to address potential levee failure and associated hazards	POEM / Bureau of Water, Fire Bureau, BES	DELETED	Moved to LT MH #10							
LT EQ 10	Identify secondary hazards generated from earthquake-generated landslides and all other secondary implications	POEM	Deferred Changed to LT timeline	Multnomah County NHMP Addresses Landslides		X			X	X	
LT-EQ#11	Work with local jurisdictions to assess the capacity of landfill to accommodate earthquake debris: develop coordination plans for disposal of debris in the aftermath of an earthquake	POEM / Bureau of Planning and Sustainability	Ongoing moved from STEQ7	Metro: Solid waste and recycling department. "Emergency Response Plan Multnomah County NHMP addresses debris removal					X	X	
EQ	Encourage utility companies to evaluate and harden vulnerable infrastructure elements for sustainability	Ne	w Implement		X				X		

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EROSION – (ER) NEW HAZARD											
ER	Maintain and update erosion hazard location maps, identify critical facilities potentially impacted and develop mitigation initiatives such as bank stabilization or facility relocation to prevent or reduce the threat (NFIP Compliance)		New Implement	Combine all mapping activities under MH	X				X	X	X
ER	Relocate buildings that are at risk of erosion impacts (NFIP Compliance)		New Implement	Combined relocation activities under MH		X			X		
ER	Implement projects that retain native vegetation, increase vegetation diversity and increase the complexity of the vegetation strata (having three vegetation strata: herbs, shrubs, trees)	BES, Parks, BPS	New Implement			X			X		
ER	Implement policies to increase the extent of coverage of the Greenway zones and further limit proposed activities within these areas	BES, BDS, BPS	New Implement			X	X		X		
ER	Initiate and enforce speed limits for boats on the Willamette River where natural banks are currently eroding due to boat wakes	Multnomah County Sheriff River Patrol	New Implement	"Slow no wake" signs being set up		X	X		X	X	
ER	Develop standards for soil backfill in vegetated areas, especially sloped areas	BES	New Implement			X			X		
ER	Establish regulations that prevent installation of slopes steeper than 3:1 and prohibit development on slopes steeper than 3:1	BDS, BPS, BES	New Implement			X			X		
ER	Implement projects that layback and/or regrade riverbank slopes and secure wetland sod mats composed of native emergent/grasses, etc..	Bureau of Parks and Recreation	New Implement			X					
ER	Construct bioengineered slope protective measures such as brush bundles, fascines, brush matresses, etc	Bureau of Parks and Recreation	New Implement			X			X		
ER	Implement projects that increase large wood structures that act to soften the effect of wave action on shorelines as well as provide habitat for migrating salmonids	BES	New Implement			X			X		
ER	Secure large wood [boles w/ attached root wads] or log rafts to reduce high wave action that can result in erosion	Bureau of Parks and Recreation	New Implement			X					
FLOOD											
ST FL #1	A covenant is recorded with the deed of new development in the floodplain to ensure that space below the BFE is not converted to habitable space. This should be codified to improve compliance (NFIP Compliance)	BDS	Ongoing	Building permit and codes developed and implemented		X			X		
ST FL #2	Continue to co-fund improvements to river and stream gauges in the Portland metropolitan area with the United Geological Survey	BES	Complete and Ongoing	BES and USGS renewing a 5 year agreement to co-fund improvements to river and stream gauges				X	X	X	
ST FL #3	Convene an interagency committee to determine which datum will be used when the City is responding to a flood event. This decision will not preclude agencies from using their own datum during non-flood times	Fire Bureau / BDS, POEM	Complete	Calibration of river datum chart aligning each rivers' gauge settings	X						

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ST FL #4	Secure the agreements necessary to design and implement the redevelopment of Freeway Land Company site (within the Lents Urban Renewal Area)	BDS /Portland Development Commission; Bureau of Planning and Sustainability, PBOT, Portland Parks and Recreation	Ongoing	This is an ongoing process							X
ST FL #5	Acquire outside funding to hire a consultant to lead the application process for a Class 5 rating the next time the City submits for the Community Rating System certification	BES, Community Rating System Coordinator / BDS; Bureau of Planning and Sustainability; Bureau of Parks and Recreation; POEM; PBOT	Complete and Ongoing	Working on getting a Class 5 rating with next CRS update.		X	X	X	X	X	
ST FL #6	Support Multnomah County Drainage District (MCDD) in the continued calibration and updating of hydraulic models for conveyance and internal flood impacts to the four managed floodplains managed by MCDD #1 (NFIP Compliance)	POEM, BES / Bureau of Planning and Sustainability	Complete and Ongoing	All of the districts continue to calibrate their H&H model using XP SWIMM					X	X	X
ST FL #7	Develop a multiple-agency plan for evacuation of the managed Columbia River floodplain in Multnomah County in the event of a potential levee failure (All floodplain areas)	POEM / PBOT	Deleted	Combined all evacuation actions under MH							
ST FL #8	Identify funding for the design and construction of the Springwater Wetlands Complex, a 30-acre floodplain wetland restoration project in the Lents area of Johnson Creek	BES, Johnson Creek Watershed Manager / Portland Development Commission, Bureau of Parks and Recreation	Ongoing	Funding provided to bring project to 90% design and 90% design completed. Funding for construction not yet earmarked by Congress					X		X
ST FL #9	Secure funding to implement the passive flood management projects that are recommended in the Johnson Creek Restoration Plan & other watershed management plans. Coordinate with Portland Development Commission's urban renewal efforts in Lents and with other partners in other parts of the watershed	Johnson Creek Watershed Manager, BES / Bureau of Parks and Recreation, Portland Development Commission	Complete and Ongoing				X	X	X	X	X
ST FL #10	Improve definitions and refine standards for storm water retention in the Stormwater Management Manual	Development Services Division, BES / BDS, Bureau of Planning and Sustainability	Complete and Ongoing	Complete. Comprehensive Plan (No development in areas where stormwater cannot be managed)							
ST FL #11	Support development of a multiple-agency plan for Marine Drive closure coordination	POEM / Bureau of Water, PBOT	DELETED	Moved to MH							
ST FL #12	Install a river gauge in the vicinity of the bridge over Johnson Creek at 108th. The gauge should be able to send data to remote monitoring sites	POEM/ BBOT, Police, Bureau of Water	DELETED	Moved to LT FL Not yet done Revisit this item after East Lents project is completed			X		X		
ST FL #13	Install one-way valves on the outlet pipes of the storm inlets on SE Foster Road between 101st and 112th	PBOT, Environmental Systems Division Manager / BES; PBOT	DELETED	Moved to LT FL							
LT FL #1	Increase funding for the Johnson Creek Willing Seller Program; establish willing seller programs in other watersheds where flood hazard and priority restoration areas coexist (NFIP Compliance)	Watershed Managers, BES / Bureau of Parks and Recreation, Bureau of Planning and Sustainability,, Bureau of Water	Complete and Ongoing	Funding for the Johnson Creek Willing Seller Program increased to $21 million for 80 acres Gray to Green program funds land acquisition throughout the City				X	X	X	X

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LT FL #2	Review and amend City Code to require that all facilities that store or handle hazardous materials (including large tanks) and which are located in the 500-year floodplain or landslide hazard areas, develop a hazardous materials inventory statement. This statement will be made available for Fire Bureau review. Require that these storage tanks are either adequately protected or relocated outside of the 500 year floodplain (NFIP Compliance)	Fire Marshal / Fire Bureau, POEM, BES	DELETED	Duplicate Project Move to MH							
LT FL #3	Develop a plan for addressing flooding in the Holgate Lake area (NFIP Compliance)	BES /BDS, Bureau of Parks and Recreation, Bureau of Planning and Sustainability	Ongoing	USGS published Hydrology of the Johnson Creek Basin in 2009			X		X	X	
LT FL #4	Improve hydraulic bottleneck that prevents discharge of chlorinated effluent to the Willamette River during high river levels (NFIP Compliance)	Operating Manager Tryon Creek Wastewater Treatment Plant, BES	Deferred	benefit does not justify the cost of the project. BES will reevaluate	X				X		
LT FL #5	As Waterfront Park remodeling is designed, ensure that Portland's downtown property and critical facilities remain protected from floodwaters (NFIP Compliance)	Bureau of Parks and Recreation / Fire Bureau, Bureau of Planning and Sustainability, BDS	Ongoing	POEM reviews planning intentions for this area and river reaches	X	X	X		X	X	
LT FL #6/#7	Partner with Army Corps of Engineers to conduct modeling of the Willamette River upstream of Portland to identify areas that, if acquired or restored, would contribute to mitigate of peak flows in Portland or result in significant reduction of flood damages. (NFIP Compliance)	BES Systems Analysis Group	Deferred	Due to lack of staff and resources		X			X	X	X
LT FL #8	Develop citywide, watershed or sub-watershed specific goals, policies and provisions for amount of impervious surface that should be reduced. Develop implementation tools to meet these goals	Bureau of Planning and Sustainability,, BES / BDS, PBOT	Deleted	Reword to better reflect need							
New LT FL #8	Develop goals, policies and implementation measures to manage the amount of new impervious surface and remove existing impervious surfaces where appropriate. These goals, policies and measures may be at the citywide, watershed, or sub-watershed level (NFIP Compliance)	BES	Reword	Economic analysis documents for South Portland buttes.					X	X	X
LT FL #9	Upgrade trestles that carry the main conduits of the water delivery system	Bureau of Water	Deferred Ongoing	Due to lack of funding. Currently defined in the Water Bureau's 5 year CIP Plan					X		
LT FL #10	Create redundancy in the water delivery system at the three Sandy River crossings by burying conduits under the river	Bureau of Water, Operations and Support Manager	Deferred Ongoing	Due to lack of funding	X	X			X		

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LT FL #11	Provide funding for and participate in development of a flood inundation model for the managed floodplains and downtown sea wall (NFIP Compliance)	POEM / BES, Bureau of Water	Ongoing	Not fully developed or utilized due to lack of funding	X	X			X	X	X
New LT FL #12	Install a river gauge in the vicinity of the bridge over Johnson Creek at 108th. The gauge should be able to send data to remote monitoring sites. (NFIP Compliance)	POEM / PBOT, Police, Bureau of Water	Deferred	Not yet done. Revisit this item after East Lents project is completed					X	X	
New LT FL #13	Install one-way valves on the outlet pipes of the storm inlets on SE Foster Road between 101st and 112th	PBOT, Environmental Systems Division Manager / BES; PBOT	Deferred Ongoing	Due to lack of funding and staff resources		X				X	
New LT FL	Through the Comprehensive Plan or other plans Develop new zoning codes for the Holgate Lake area using data obtained from the 2009 USGS Holgate Lake Hydrology Study (obtained from LT FL #3) (NFIP Compliance)	Bureau of Planning and Sustainability	New Implement		X	X				X	
New LT FL	Through the Comprehensive Plan or other plans consider limiting or restricting development in flood prone areas with poorly infiltrating soils and or high groundwater where stormwater cannot be retained onsite (NFIP Compliance)	Bureau of Planning and Sustainability	New Implement LT Ongoing			X				X	
FL	Complete update to the Johnson Creek Restoration Plan. Develop individual plans for each sub-watershed to address the sources of excess stormwater runoff that exacerbates flooding (NFIP Compliance)	BES	New Implement	This will be a Bureau planning action item		X				X	
FL	Through the Comprehensive Plan update implement Citywide policies, land use improvements and mapping changes that reduce landslide, flood, earthquake and wildfire hazards (NFIP Compliance)	POEM – all bureau review	New – Consider	2012		X				X	
FL	Implement actions in the 2005 Portland watershed management Plan (PWMP) to help mitigate flood, landslide, earthquake and wildfire hazards (NFIP Compliance)	BES	Change to ST MH 11			X				X	
FL	Continue to reduce the vulnerability of the Water Bureau's groundwater system i.e. flooding and electrical.	Water Bureau	New Implement								
FL	Establish flood mitigation priorities for critical facilities and residential and commercial buildings located within the 100- year floodplain using survey elevation data. (NFIP Compliance)	POEM, all bureaus	New Implement Move to MH 25	Research is needed, complete as funding allows		X			X		
FL	Increase culvert size to increase its drainage efficiency.		New Implement			X			X		
FL	Construct debris basins to retain debris in order to prevent downstream drainage structure clogging.	Ne	w Implement			X			X		
INVASIVE PLANT SPECIES (IS) – NEW HAZARD											
IS	Update Invasive Species Plants List by consolidating nuisance and prohibited plant lists into one "Nuisance Plants List" and assigning priority ranks to the Nuisance Plants List	BPS	New Implement			X			X	X	
IS	Establish the Portland Plant List as an administrative rule (instead of an ordinance	BPS	New Implement			X			X	X	

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IS	Clarify zoning regulations to require removal of plants on the Nuisance Plants List in conjunction with required landscaping	BPS	New Implement			X			X	X	
IS	Clarify zoning regulations to require removal of plants on the Nuisance Plants List in the Environmental, Greenway and Pleasant Valley Natural Resources Overlay Zones and the Columbia South Shore and Johnson Creek Basin Plan Districts	BPS	New Implement			X			X	X	
IS	Establish rules requiring that certain early detection species on the Nuisance Plants List be eradicated from a property if discovered	BPS	New Implement			X			X	X	
IS	Initiate a process to ensure the Erosion Control Manual be made consistent with City goals to control and eradicate invasive plants	BPS, BES, BDS	New Implement			X			X	X	
IS	Initiate a process to ensure the Tree and Landscaping Manual, the Recommended Street Tree List and the Stormwater Management Manual be made consistent with City goals to control and eradicate invasive plants	BPS, BES, BDS, PP&R	New Implement			X			X	X	
IS	Coordinate with the Portland Plan project to help ensure that invasive species are addressed in the Comprehensive Plan update and Portland Plan work plan	BPS	New Implement			X			X	X	
IS	Research the feasibility of establishing a local noxious or invasive weed law	BPS	New Implement			X			X	X	
LANDSLIDE (LS)											
ST-LS #1	Continue to Maintain and Improve Internal City communications to facilitate coordination of landslide mitigation activities	BDS/ BES, PBOT, Bureau of Water, Bureau of Parks and Recreation, Risk Management	Complete and Ongoing	The landslide coordination committee has streamlined city services which benefit at least 6 different bureaus							
ST-LS #2	Improve property owner awareness of the importance of proper maintenance of private drainage systems	BES /PBOT	Complete	River East Center provides opportunities for the public to become more aware of innovative stormwater management techniques 34 in-depth interviews conducted in and around the Taggart D Basin of Southeast Portland. All interviews ascertained public awareness of storm water management in southeast Portland BES developed: Maintaining your storm water management facility. Home owners handbook			X		X		
ST-LS #3	Mitigate Portland's water supply infrastructure from landslide hazards	Bureau of Water	Ongoing	Significant elements of a landslide monitoring system are in place.					X	X	
ST-LS # 4	Initiate more operations and maintenance pilot projects along roads that inform about the development of standards for managing stormwater in ditches in landslide prone areas	BES /PBOT	Complete and Ongoing						X	X	
ST-LS #5	Continue development of standards for small pump stations as an alternative to gravity sewers in accessible or high risk areas	BES/ BDS	DELETED	Convert to Long-Term action item	X						
LT-LS # 1	Develop a comprehensive landslide map for the City to identify hazard areas and to improve communications with the public	BDS / Bureau of Planning and Sustainability, Bureau of Water/ BES, PBOT, Bureau of Parks and Recreation	Complete and Ongoing	BDS provides potential landslide hazard map		X	X			X	

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LT-LS #2	Acquire land or apply conservation easement for long-term and permanent mitigation of risk	BGS / Bureau of Planning and Sustainability, Bureau of Parks and Recreation, BDS BES, Risk Management	DELETED Combined all acquisition/relocation/demolition actions in MH	Combined all acquisition/relocation activities under MH							
LT-LS #3	Complete a study of the West Hills drainage system which addresses the cumulative effects of development in the Area	BES, Planning and Modeling and Engineering Services, Bureau of Planning and Sustainability, BDS (Site Development)	DELETED	Reworded							
New LT LS #3	Evaluate the role of drainage systems in the West Hills, including pipes, streams and drainage ways and options for protecting and improving their functions and increasing their resiliency	BES, Planning and Modeling and Engineering Services, Bureau of Planning and Sustainability, BDS (Site Development)	Complete and Ongoing	Reworded	X		X	X		X	
LT-LS # 4	Review the effectiveness of regulations related to development in identified landslide area.	BDS (Land Use Services and Site Development), Bureau of Planning and Sustainability, BES	Deferred	Due to lack of funding No review process completed,							
New LT LS #4	Review the effectiveness of existing regulations related to development in landslide hazard areas	BDS (Land Use Services and Site Development), Bureau of Planning and Sustainability, BES	Deferred	Reworded					X	X	
LT-LS # 5	Update the Bureau of Environmental Service's Sewer and Drainage Facilities Design Manual	BES	Complete	Completed June 2007 and updated November 2008							
LT-LS #6	Employ alternative construction methods such as trenchless construction on City projects to reduce the impact that development can have in landslide prone areas	BES	Complete and Ongoing	BES uses alternate construction methods in steep areas				X	X		
New LT LS #7	Construct a catch basin ahead of the TCWTP to catch excess flows	BES, BDS	Converted to LT Action Item	Replaces ST LS #5		X		X	X	X	
SEVERE WEATHER					X						
ST SW #1	Develop an education/outreach program in collaboration with other bureaus regarding winter preparedness that targets Portland's neighborhoods	PDOT, POEM, Bureau of Water, BES, Office of Neighborhood Involvement	DELETED	Combined all outreach activities under MH General preparedness for winter and ice; snow and ice routes map available							
ST SW #2	Acquire an additional facility for storage of anti-icing materials and expand anti-icing vehicle inventory	PDOT BGS/Facilities, Vehicle Services	Ongoing Move to MH 26			X			X	X	
ST SW #3	Manage the planting and maintenance of trees in the public right of way to minimize risk	City Forester (Bureau of Parks and Recreation), PDOT	Complete								
ST SW #4	Visually assess overhead hazards during development permit reviews	POEM	DELETED	Deleted due to funding, staff resources and infeasibility							
ST SW #5	Develop, implement and/or enhance strategies for debris management for severe winter storm events	BES	Ongoing	The City's street cleaning program removes dirt and debris from City streets and provides emergency response in winter storms					X	X	
ST SW #6	Insulate residential buildings that house at-risk populations	PDC	Ongoing			X	X		X		
ST SW #7	Prioritize existing building stock for active review of Title 29 (Dangerous Building Code) This needs to be updated with intern information or information sent from individuals that are on the team	BDS	Deferred	The Bureau does not review existing building stock Inspectors will become aware of a dangerous conditions and then follow-through with the owner to get that dangerous condition fixed	X				X	X	

Table C-4a Mitigation Goals and Full List of Action Items (2004 action items and 2010 proposed action items, status and alignment with 2010 goals)

Actions					2010 Goals						
ID	Description	Coordinating Organizations/ Internal Partners	Status: Complete, Deferred, Deleted, Ongoing, or New - Consider or Selected to Implement	Status / Comments	1. Update risk and vulnerability analysis every five years	2. Implement actions to protect life, property and natural systems	3. Promote public outreach to diverse populations	4. Improve City of Portland's economic resilience by identifying mitigation action successes.	5. Commit to continuously reducing the City's natural hazards vulnerability.	6. Cross reference NHMP goals and actions with all City plans, projects and program investments.	7. Coordinate mitigation activities with regional communities and agencies.
SW	Develop and implement programs to coordinate maintenance and mitigation activities to reduce risk to public infrastructure from severe winter storms		New Implement Combined in MH 20 & MH 25	Review and incorporate as appropriate		X		X	X		
SW	Develop critical facility list needing emergency back-up power systems, prioritize, seek funding and implement mitigation actions		New Implement Combined in MH 20 & MH 25	Review and incorporate as appropriate		X		X	X		
SW	Develop and implement tree maintenance and mitigation programs to keep trees from threatening lives, property and public infrastructure from severe weather events		New Implement Combined in MH 20	Review and incorporate as appropriate		X		X	X		
SW	Develop, implement and maintain partnership program with electrical utilities to identify key repetitive loss areas and develop mitigation techniques		New Implement	Review and incorporate as appropriate		X		X	X		
SW	Increase power line wire size and incorporate quick disconnects (break away devices) to reduce ice load power line severe wind or winter ice storm event failure		Ongoing	Review and incorporate as appropriate		X		X	X		
SW	Partner with PGE to provide a robust underground feed for power and communications at headworks treatment at Bull Run to ensure uninterrupted treatment		Ongoing	Review and incorporate as appropriate		X		X	X		
ST SW #1	Develop an education/outreach program in collaboration with other bureaus regarding winter preparedness that targets Portland's neighborhoods	PDOT, POEM, Bureau of Water, BES, Office of Neighborhood Involvement	DELETED	Combined all outreach activities under MH General preparedness for winter and ice; snow and ice routes map available							
ST SW #2	Acquire an additional facility for storage of anti-icing materials and expand anti-icing vehicle inventory	PDOT BGS/Facilities, Vehicle Services	Ongoing Move to MH 26			X			X	X	
ST SW #3	Manage the planting and maintenance of trees in the public right of way to minimize risk	City Forester (Bureau of Parks and Recreation), PDOT	Complete								
ST SW #4	Visually assess overhead hazards during development permit reviews	POEM	DELETED	Deleted due to funding, staff resources and infeasibility							
ST SW #5	Develop, implement and/or enhance strategies for debris management for severe winter storm events	BES	Ongoing	The City's street cleaning program removes dirt and debris from City streets and provides emergency response in winter storms					X	X	
VOLCANO (V) – NEW HAZARD											
V	Update public outreach program for ash fall events.		New Implement	Combined all outreach activities in MH							
V	Evaluate capability of water treatment plants to deal with high turbidity from ash falls and upgrade treatment facilities' physical plant to deal with ash falls. Prioritize and initiate actions to fill capability gaps.		New Implement		X						
V	Identify and prioritize critical facilities' overhead utilities that could be placed underground to reduce power disruption from wind storm / tree blow down damage		New Implement Move to MH 25								
V	Work with the state and other impacted jurisdictions to implement and update the various volcano Inter-Agency Coordination Plans	POEM	New Implement							X	X
V	Collaborate with USGS-CVO and related agencies to develop ash fall models that are specific to the City	POEM	New Implement			X					X
WILDLAND URBAN INTERFACE FIRE (WF)											
ST WF #1	Consolidate unassigned and/or unmanaged vegetated areas owned by the City under a single land management umbrella	Bureau of Parks and Recreation, BES / Bureau of Water, PBOT, BGS	Ongoing	No available funds to actively reduce fuels or manage vegetation					X	X	

Table C-4a Mitigation Goals and Full List of Action Items (2004 action items and 2010 proposed action items, status and alignment with 2010 goals)

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ID	Description	Coordinating Organizations/ Internal Partners	Status: Complete, Deferred, Deleted, Ongoing, or New - Consider or Selected to Implement	Status / Comments	1. Update risk and vulnerability analysis every five years	2. Implement actions to protect life, property and natural systems	3. Promote public outreach to diverse populations	4. Improve City of Portland's economic resilience by identifying mitigation action successes.	5. Commit to continuously reducing the City's natural hazards vulnerability.	6. Cross reference NHMP goals and actions with all City plans, projects and program investments.	7. Coordinate mitigation activities with regional communities and agencies.
ST WF #2	Procure funding for management of vegetated natural areas with high wildfire danger, including public and private properties	Fire, Bureau of Parks and Recreation, BES, Bureau of Planning and Sustainability, PBOT, BGS	Ongoing	This task is currently funded through 2010 through a FEMA PDM grant			X		X	X	
ST WF #3	Review and index existing maps with pertinent wildfire information. Identify parameters and methods for new maps as needed to meet wildfire mitigation goals	Fire, BDS, Corporate GIS / BIT, Bureau of Planning and Sustainability, Bureau of Parks and Recreation, BES, Bureau of Water	Ongoing	Current wildfire hazard maps are not accurate at a small scale and would be difficult for code enforcement	X				X	X	
ST WF #4	Provide wildfire management training to staff	Portland Fire and Rescue / Bureau of Parks and Recreation, BES, Bureau of Water, PBOT	Ongoing	Portland Fire has two courses currently offered (S190 & S130).			X		X	X	
ST WF #5	Amend the Portland Plant List and other related City plant lists and landscaping guides to include/identify fire resistant native plants and planting strategies that could be encouraged or required in local landscaping	Bureau of Planning and Sustainability/ Fire and Rescue, Bureau of Parks and Recreation, BES, PBOT	Ongoing	Updated Portland Plant List in 2004-2005 indicated fire accelerant plants, The 2005 Environmental Code Improvement Project					X	X	X
ST WF #6	Integrate, as appropriate, fire prevention goals and provisions into City policies, plans and codes. Identify and address ambiguities or conflicts among city requirements	Bureau of Planning and Sustainability/ BDS, Fire and Rescue, BES, PBOT	Ongoing	Portions within Bureau of Planning work plans					X	X	
ST WF #7	Identify conditions of approval and mitigation strategies that could be applied to new development or redevelopment in high risk areas	BDS, Bureau of Parks and Recreation, Bureau of Planning and Sustainability, Fire and Rescue, BES and PBOT	Ongoing	Used on a case by case basis by BDS		X				X	
ST WF #8	Integrate wild land fire risk educational opportunities into existing City stewardship programs. Provide education for both internal and external partners. Define and refine. Resource Protection. Eddy Campbell Add wording for funding when funding becomes available	BES, Bureau of Parks and Recreation; Fire and Rescue, Bureau of Water, Bureau of Planning and Sustainability, BDS, BOT, POEM, Office of Neighborhood Involvement	DELETED	Combined all outreach activities under MH Need consistent funding sources							
ST WF #9	Improve the system for identifying new construction in areas subject to wildfires and communicating this information to the affected land owners	BDS / Fire and Rescue; Bureau of Water, PBOT, Office of Neighborhood Involvement, Bureau of Planning and Sustainability	Ongoing	Information is not always effectively communicated during the permitting process		X	X		X		
ST WF #10	Conduct systematic reviews of Portland's large, publicly owned, wildland tracts regarding fire safety and ecological health to inform land management decisions.	Bureau of Parks and Recreation / BES, Fire and Rescue, Bureau of Water, Bureau of Planning and Sustainability, PBOT, Office of Neighborhood Involvement	Ongoing	Portland Park and Recreation is currently working on natural area ecosystem management plans.	X		X			X	
ST WF #11	Adopt the national "Fire Danger Rating System" and install the signs at key points in the City.	Fire and Rescue / Office of Neighborhood Involvement	Ongoing	The rating system is designed to remind the public to be extra cautious during critical r fire danger periods.			X				X
ST WF #12	Implement a neighborhood wildland interface disaster planning program.	POEM, Neighborhood Emergency Team, Office of Neighborhood Involvement / Fire and Rescue, Police	Ongoing	The neighbors surrounding wildland interface areas are key partners in loss prevention.			X		X	X	
ST WF #13	Review and potentially refine City contract specifications for machinery operations during "Red Flag" weather conditions.	Fire and Rescue / BES, Bureau of Parks and Recreation, Bureau of Water	Ongoing		X		X		X		
ST WF #14	Convene a standing wildland interface fire technical group.	Fire and Rescue / Bureau of Parks and Recreation, BES, POEM, Bureau of Water, PBOT, BDS, Bureau of Planning and Sustainability	Ongoing	This group would provide an ongoing forum platform to discuss and coordinate implementation of wildfire mitigation actions across City bureaus and ensure actions are reasonably and equitably supplied. To be qualify for a Community Wildfire Community Plan, Multnomah Co and City must convene this group.	X	X	X	X	X	X	X

Table C-4a Mitigation Goals and Full List of Action Items (2004 action items and 2010 proposed action items, status and alignment with 2010 goals)

Actions					2010 Goals						
ID	Description	Coordinating Organizations/ Internal Partners	Status: Complete, Deferred, Deleted, Ongoing, or New - Consider or Selected to Implement	Status / Comments	1. Update risk and vulnerability analysis every five years	2. Implement actions to protect life, property and natural systems	3. Promote public outreach to diverse populations	4. Improve City of Portland's economic resilience by identifying mitigation action successes.	5. Commit to continuously reducing the City's natural hazards vulnerability.	6. Cross reference NHMP goals and actions with all City plans, projects and program investments.	7. Coordinate mitigation activities with regional communities and agencies.
ST WF #15	Index City wildfire mitigation plans and activities.	Fire and Rescue / Bureau of Parks and Recreation, BES, POEM, BOT, Metro, BDS, Bureau of Planning and Sustainability	Ongoing	Tracking current activities helps direct limited resources, key priorities, eliminate redundancy and id gaps. Will be an action item of committee.					X	X	
New ST WF #16	Identify water grid engineering requirements for firefighting in wildfire areas	Bureau of Fire and Rescue, Bureau of Water	Deferred	Work has been initiated by the Water Bureau. Representatives from the Bureau of fire should meet with Water Bureau representatives to identify State and Federal criterion/standards. Fire Bureau and Water Bureau have met numerous times to discuss standards and priorities. A prioritization memorandum that identifies areas of the most concern has been prepared by the Fire Bureau and the Water Bureau.						X	
LT WF #1	Improve public education and understanding about wildfire occurrence, risk and prevention. Move to Public.	Portland Fire and Rescue / Parks, BES, PBOT, Bureau of Planning and Sustainability	DELETED	Combined all outreach activities under Multi-Hazard Section	X						
LT WF #2	Review the feasibility of adopting portions of nationally recognized wildfire interface codes to strengthen building standards in wildfire risk areas.	Portland Fire & Rescue, BDS	Ongoing	Wildfire interface codes are a model for requiring stricter building standards for new buildings in interface areas.			X			X	X
LT WF #3	Design and conduct a study to determine the effectiveness of maintenance agreements that are established when new land divisions are approved to manage vegetation in open space tracts.	BDS; Fire and Rescue / Bureau of Planning and Sustainability, Bureau of Parks and Recreation, BES, PBOT and the Office of Neighborhood Involvement	Ongoing	Allows the City to ensure maintenance agreement requirements are effectively implemented.	X					X	
LT WF #4	Complete an assessment to characterize high priority wildfire risk areas and recommend specific mitigation strategies.	Fire and Rescue / Bureau of Parks and Recreation, BES, Bureau of Planning and Sustainability, BDS, Bureau of Water, PBOT	Complete and Ongoing	This has been implemented by PDM grant and has helped in limited areas. This activity will provide information for a benefit cost analysis for actions to be developed.	X						
LT WF #5	Explore avenues for funding interface home construction upgrades for low income homeowners.	Fire and Rescue / BDS, Office of Neighborhood Involvement	Deferred	Have no idea if anything has been accomplished in this area by other Bureaus. PF&R should not be involved if this remains in the mitigation plan.			X			X	X
WF	Develop, adopt and enforce burn ordinances that require burn permits, restrict campfires and controls outdoor burning.	Ne	w Implement				X		X	X	
WF	Complete engineering work to analyze the fire risk potential of the Bull Run Watershed. Implement appropriate actions as determined from the engineering work.	Ne	w Implement			X			X	X	

CITY OF PORTLAND NATURAL HAZARD MITIGATION PLAN UPDATE

September 2009

This newsletter discusses the Portland Natural Hazard Mitigation Plan Update activity. It has been prepared to inform interested agencies, stakeholders, and the public about the project and to solicit comments. This newsletter can also be viewed on the City of Portland Office of Emergency Management Website at: www.portlandonline.com/oem

The City of Portland Office of Emergency Management (POEM) is updating the City's Natural Hazard Mitigation Plan (HMP) and solicits public participation.

The Portland Natural Hazard Mitigation Plan will identify and update their natural hazards risks, such as flood, earthquake, weather related hazards, wildland fire, and landslides. The plan will also identify the people and facilities potentially at risk and ways to mitigate damage from hazards. The public participation and planning process will be documented as part of the project.

What is Hazard Mitigation?

Across the United States, natural and human-caused disasters have increasingly caused injury, death, property damage, and business and government services interruption. The toll on individuals, families, and businesses can be very high. The time, money, and resources required to respond to and recover from disasters take public funding and attention away from other important programs.

The people and property in the City of Portland are at risk from a variety of natural hazards that can potentially cause human injury, property damage, economic hardship or environmental harm.

Hazard mitigation projects eliminate the risk or reduce the severity of hazards on people and property. Projects may include short- or long-term activities to reduce exposure to or the effects of known hazards. Hazard mitigation activities include relocating or elevating buildings, developing, implementing or enforcing building codes, using technological tools to minimize the impact of the hazard, and public education.

Above all Hazard Mitigation is the title for actions taken by the public, both individual and organizational, business and industry and governmental agencies that protect our investment in the community, the businesses, the homes and the people that make Portland, Portland.

Why Do We Need A Hazard Mitigation Plan?

Communities must have a State, FEMA approved, and community adopted mitigation plan to receive a project grant from either the Hazard Mitigation Assistance or disaster mitigation assistance programs. The City of Portland needs to update their existing EEMA approved NHMP to continue eligibility and access to not only mitigation funds but all FEMA funding.

The rules have changed. The Local government and Flood Hazard Mitigation Plans' requirements were consolidated into one planning mechanism. Additionally the Flood Mitigation Assistance (FMA), Repetitive Flood Loss (RL) and Severe Repetitive Flood Loss (SRL) programs were also consolidated with the Pre-Disaster Mitigation Grant Program under the newly developed Hazard Mitigation Assistance (HMA) program. Each of these programs must use the same application process and eligibility requirements for nationally competitive funding.

The Hazard Mitigation Grant Program (HMGP) is a disaster related assistance program. Applicants typically compete on a statewide basis.

The Planning Process

There are very specific federal requirements that must be met when preparing and updating a Hazard Mitigation Plan. These requirements are commonly referred to as the Disaster Mitigation Act of 2000, or DMA2000 criteria. Information about the requirements may be found on the Internet at: http://www.fema.gov/plan/mitplanning/guidance.shtm under Laws, Regulations, and Guidance.

The DMA2000 requires the plan to document the following topics:

- Planning process
- Hazard identification
- Risk assessment
- Mitigation Strategy: Goals, actions, and projects
- A plan adoption resolution from the community
- State and FEMA approval

FEMA has prepared Planning Guidance which is available at: http://www.fema.gov/library/viewRecord.do?id=3336; and "How to" Guides that explain in detail how each of the DMA2000 requirements is met. These guides are available at http://www.fema.gov/plan/mitplanning/resources.shtm. The Portland Hazard Mitigation Plan will follow those guidelines.

We are currently in the very beginning stages of updating the HMP. This newsletter is posted to introduce the project, planning team, and to gather comments from our community residents. Specifically we will complete the hazard identification task, and collect hazard event data to conduct the risk assessment and vulnerability analysis.

POEM previously identified hazards that were frequent or had the greatest impact to the City's infrastructure and residents. This information was reviewed and used for completing the assessment and vulnerability analysis using FEMA's Multi-Hazard US computer program in the 2004 edition.

The Planning Team

The planning team is lead by Patty Rueter, Planning Manager for POEM, with assistance from URS Corporation Planners Dautis Pearson, and Amy Lewis. URS Corporation has been contracted by POEM to provide assistance and guidance to the Planning Team throughout the planning process.

Public Participation

PUBLIC MEETINGS – Project Presentation & Data Gathering	
Location	
Date	October 1, 2009
Time	1:00 – 3:00 p.m.
Toll Free call-in number:	

Public involvement will continue throughout the project. The goal is to receive comments, identify key issues or concerns, and improve mitigation ideas. When the Draft Update of the Portland Hazard Mitigation Plan is complete, the results will be presented to the community before POEM, State, and FEMA approval, and subsequent community adoption.

We Need Your Help

Please use the following table to identify any hazards you believe should be reviewed through this Update. Please add or subtract hazards in your decision making process.

Portland Hazard Worksheet		
Hazard	Yes	No
Erosion, Coastal, Riverine, & Wind		
Earthquake		
Flood		
Landslide		
Tsunami		
Volcano		
Weather, Severe		
Drought		
Dust Storms		
El Nino Southern Oscillation		
Wind Storms		
Winter Storms		
Wildland/Urban Interface Fire		

Please list hazard events that have occurred between 2004 and the present and provide a narrative description of the damages and subsequent repair or replacement costs. Once this information is collected we will determine which critical facilities, residences, and populations are vulnerable to specific hazards in Portland. Please add additional facilities if needed.

Hazard Event Information

City of Portland Hazard Damage Data		
Hazard Event	Damage Description	Estimated Cost
Sample: 2005 Landslide	Portion of foundation sloughed away from the house due to excessive rain.	$25,000

Please email or fax updated hazard and critical facility information directly to URS.

We encourage you to take an active part in the Portland Hazard Mitigation Plan update effort. The purpose of this newsletter is to keep you informed and to allow you every opportunity to voice your opinion regarding this important project. Please contact these URS planning coordinators, if you have any questions, comments, or information requests:

Dautis Pearson
Senior Environmental Planner
URS Corporation
Portland, Oregon 97201
503.478.7663, Direct
503.222.4292, Fax
Dautis_Pearson@urscorp.com

Amy Lewis
Environmental Planner
URS Corporation
Portland, Oregon 97201
503.948.7223, Direct
Amy_Lewis@urscorp.com

City of Portland Natural Hazard Mitigation Plan Update

November 2009 Newsletter 2

This newsletter discusses the preparation of the City of Portland Hazard Mitigation Plan. It has been prepared to inform interested agencies, stakeholders, and the public about the project and to solicit comments. This newsletter can also be viewed on the Portland Office of Emergency Management Website at http://www.portlandonline.com/OEM/.

The City of Portland Office of Emergency Management (POEM) is updating the City's Natural Hazard Mitigation Plan (HMP) and solicits public participation.

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The people and property in the City of Portland are at risk from a variety of natural hazards that can potentially cause human injury, property damage, economic hardship or environmental harm.

Hazard mitigation projects eliminate the risk or reduce the severity of hazards on people and property. Projects may include short- or long-term activities to reduce exposure to or the effects of known hazards. Hazard mitigation activities include relocating or elevating buildings, developing, implementing or enforcing building codes, using technological tools to minimize the impact of the hazard, and public education.

Above all Hazard Mitigation is the title for actions taken by the public, both individual and organizational, business and industry and governmental agencies that protect our investment in the community, the businesses, the homes and the people that make Portland, Portland.

Why Do We Need A Hazard Mitigation Plan?

Communities must have a State, FEMA approved, and community adopted mitigation plan to receive a project grant from either the Hazard Mitigation Assistance or disaster mitigation assistance programs. The City of Portland needs to update their existing EEMA approved NHMP to continue eligibility and access to not only mitigation funds but all FEMA funding.

The rules have changed. The Local government and Flood Hazard Mitigation Plans' requirements and grant funding mechanisms were consolidated into one program, FEMA's Hazard Mitigation Assistance Program. The new program consolidates the Hazard Mitigation (HMGP), Pre-Disaster Mitigation (PDM) Flood Mitigation Assistance (FMA), Repetitive Flood Loss (RL), and Severe Repetitive Flood Loss (SRL) grant programs. Each of these programs must use the same application process and eligibility requirements for funding.

The Planning Process

There are very specific federal requirements that must be met when preparing and updating a Hazard Mitigation Plan. These requirements are commonly referred to as the Disaster Mitigation Act of 2000, or DMA2000 criteria. Information about the requirements may be found on the Internet at: http://www.fema.gov/plan/mitplanning/guidance.shtm under Laws, Regulations, and Guidance.

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In October 2009 the planning process kicked-off by establishing a local planning committee and providing public input opportunities. During the meeting the planning committee examined the progress achieved during the prior HMP's planning cycle and surveyed hazard event data to determine if new threats exist for the City other than earthquake, flood, landslide, severe weather, and wildland fire.

After the first public meeting, City staff and URS began identifying critical facilities (facilities that are critical to the recovery of a community), refining each hazard's profile, reassessing capabilities, and updating the City's risk assessments and vulnerability analyses. After data collection, URS helped to determine which critical facilities and

estimated populations are vulnerable to the identified hazards in Portland.

The Planning Team moved forward to refine the exiting mitigation strategy. The mitigation strategy is based on the above processes. The City's mitigation goals and actions/projects status updates were evaluated and are the foundation of the mitigation strategy. Mitigation goals are defined as general guidelines that explain what a community wants to achieve as hazard loss prevention. Goals are positively stated future situations that are typically long-range, policy-oriented statements representing community-wide visions. The Updated Goals for the City are:

1. Update the Risk Assessment and Vulnerability Analysis every five years.
2. Implement actions to prepare, protect, preserve and restore life, property, and natural systems.
3. Promote public outreach to diverse City populations.
4. Improve City of Portland's economic resilience by identifying mitigation action successes.
5. Commit to continuously reducing the City's natural hazards vulnerability.
6. Maximize mitigation effectiveness by taking a comprehensive approach to natural resource management via city plans, codes and programs that increase mitigation efforts.
7. Coordinate mitigation activities with regional communities and agencies.

Mitigation actions/projects are undertaken in order to achieve your stated objectives. The 2004 NHMP, focused on six categories: prevention, property protection, public education and awareness, natural resource protection, emergency services, and structural projects. The mitigation actions identified as a high priority by the Planning Team are listed below, and explained in more detail in the plan.

The selected projects/actions will be implemented over the next five years. A maintenance plan has also been developed for the hazard mitigation plan. It outlines how the community will monitor progress on achievement of the projects/actions that will help meet the stated goals and objectives, as well as an outline for continued public involvement.

The draft plan is available on the POEM website (http://www.portlandonline.com/OEM/) for public review and comment. Comments should be made via email, fax, or phone to the contact person below and be received no later than November 25, 2009. The plan will be provided to the Oregon Emergency Management Office and FEMA for their approval prior to formal adoption by the Portland City Council.

Sample of the City of Portland' Mitigation Actions. Review the draft HMP for a complete list.

Revise Portland's Comprehensive Plan to address all natural hazards including, but not limited to, earthquakes, erosion, floods, invasive plants, landslides, volcano, severe weather, and wildfires.	Identify and pursue funding opportunities from outside agencies to fund and implement identified mitigation projects and activities.	Acquire (buy-out), demolish, or relocate structures from hazard prone area. Property deeds shall be restricted for open space uses in perpetuity to keep people from rebuilding in hazard areas.
Create a mitigation mapping committee to index and maintain GIS mapped inventory, and develop prioritized list of critical facilities, residential, and commercial buildings within known hazard areas such as earthquake, erosion, the 100-year and 500-year floodplains, invasive plant species, landslide, and wildfire areas.	Cross reference and incorporate mitigation planning provisions into all community planning processes such as comprehensive, capital improvement, and land use plans, etc to demonstrate multi-benefit considerations and strengthen eligibility from multiple funding sources.	Implement projects that *retain native vegetation*, increase vegetation diversity, and increase the complexity of the vegetation strata (having three vegetation strata: herbs, shrubs, trees).
Develop educational materials (television and print media) for residents that identify and define their risk to multi hazards: define and offer mitigation measures that residents can take home or share, determine method of distribution of the educational materials, and coordinate with the media to reduce conveyance of misinformation.	Review and amend City Code to require that all facilities that store or handle hazardous materials (including large tanks), and which are located in the 500-year floodplain, landslide, or other hazard areas, develop a hazardous materials inventory statement. This statement will be made available for Fire Bureau review. Require that these storage tanks are either adequately protected or relocated outside of the 500 year floodplain, landslide, or other hazard areas.	Develop and implement protocol for defining and mapping Wildland Urban Interface Zones and develop recommended policies, regulations, and landscape options for incorporation into City plans and programs.

We encourage you to take an active part in the Portland Hazard Mitigation Plan update effort. The purpose of this newsletter is to keep you informed and to allow you every opportunity to voice your opinion regarding this important project. Please contact these URS planning coordinators, if you have any questions, comments, or information requests:

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Senior Environmental Planner
URS Corporation
Portland, Oregon 97201
503.478.7663, Direct
503.222.4292, Fax
Dautis_Pearson@urscorp.com

Amy Lewis
Environmental Planner
URS Corporation
Portland, Oregon 97201
503.948.7223, Direct
503-222-4292 Fax
Amy_Lewis@urscorp.com

Newsletter 2

Sam Adams, Mayor
Carmen Merlo, Director
1001 SW 5th Avenue, Suite 650
Portland, Oregon 97204
Phone: 503-823-4375
Fax: 503-823-3903
TDD: 503-823-6868
www.portlandonline.com/oem

-Agenda-

Hazard Mitigation Plan Update – Planning Team Meeting #1
October 1, 2009 – 1:00PM-3:00PM
Portland Building, 3rd Floor, Blazed Alder Room

1. – Introduction – Dautis Pearson/Patty Rueter **15 minutes**
Team introductions and areas of expertise

2. – FEMA Training Update – Laura Young **25 minutes**
Review of FEMA updated requirements

3. – Reporting of Hazard Areas and Data Needs – All **60 minutes**
Each hazard team lead will report on the elements of their respective hazards (earthquake, floods, landslide, severe weather, wildfire):

- Do the goals from the previous plan still fit?
- What was accomplished out of the previous plan (i.e. did we do what we said we would)?
- What modifications and accomplishments can we take credit for?
- Did the Grants and process work?
- What do you think of the process and maintenance of the process?
- What information do we still need?
- Did we do what we said we were going to do? If not, why not?

4. – Review Items for Next Planning Meeting – All **20 minutes**
Next steps and project schedule

Please review attached information and be prepared to answer above questions please! Thank you!

Natural Hazard Mitigation Plan Update
Meeting #1 October 1, 2009

PORTLAND OEM
OFFICE OF EMERGENCY MANAGEMENT

NAME	BUREAU	PHONE CONTACT	HAZARD AREA
Patty Rueter	POEM	8233809	All
Lisa Pfeffer	PSU	503/282-6521	ALL
Robert Jortner	BPS	3 7855	Fire, Flood,
Tricia Sears	BPS	503-823-4174	landslides etc
Larry Stevens	PBOT	823-7052	All
Kelli McCarthy	PFB	503 823-3931	Fire
Matthew Silva	PFB	503-793-0260	Fire
Mark Wilson	PPR	[illegible]	Wildfire
Ali Yama	BES	503-823-5[illegible]	Flood
David Harrington	PBOT	503.823.1789	Weather
Tom Canfield	PBOT	503-823-5172	Landslides

Natural Hazard Mitigation Plan Update
Meeting #1 October 1, 2009

PORTLAND OEM
OFFICE OF EMERGENCY MANAGEMENT

NAME	BUREAU	PHONE CONTACT	HAZARD AREA
Brandon Davis	BES	x32625	Earthquake
Paul Suto	BES	x32436	Earthquake
Kevin Veaudry Casaus	BPS	3-5545	All
David O'Longaigh	PBOT	3-0371	EQ, Landslide
Jamaal Folsom	PWB	3-7155	multi, flood, EQ landslide, wildfire
DAVID PEARSON	CONTRACTOR URS	503.478.7463	—
AMY LEWIS	URS - contractor	503-948-7223	—

Meeting #1 October 1, 2009

Meeting Minutes:

Introductions: Patty Rueter began with a welcome and introductions of attendees and areas of expertise (see attendance document).

- It appeared that all bureaus were represented. Staff from URS included Laura Young, Scott Simmons, and Amy Lewis from the Anchorage URS Office and Dautis Pearson from the Portland URS Office.
- Patty discussed the importance of this update and what is expected of each of the Hazard leads in the completion of the HMP update.
- Discussion of schedule: Due date December 31st, 2009, Draft to State and FEMA November 16th to meet this deadline. October to identify additional hazards, review goals, prioritize hazards, and finalization of the HMP.

FEMA Training Update: Laura Young and Scott Simmons gave a summary of the FEMA Hazard Mitigation Planning update and training process.

- Self evaluation process for past plan and update of the new plan (questions)
- Elements of the plan/Planning Process:
    - Collect, Review, and describe existing plans
    - Public outreach process (1st Scoping notice completed and under review by Patty and posting on the city website.
    - Involvement or outreach to others in the community
    - Documentation example for planning process
- Risk Assessment
    - Hazard identification and selection, hazard profiles, assessing vulnerability – URS compiled the previous hazards and provided the group with a spreadsheet to work from.
    - Several examples were provide to the group by URS and the City (Hazare Screening Matrix, Risk assessment worksheet, and handout of FEMA examples.
- Mitigation Strategy
    - Criteria of capability assessment, mitigation goals, analysis of mitigation actions, and implementation should be used to evaluate mitigation items. URS provided additional samples for use in this process
    - Each hazard lead will be required to complete this process before the next planning meeting.
- Plan Maintenance Process
    - URS provided directions and examples for plan maintenance including monitoring, incorporation into existing plans, and continued public involvement. It was established that the update would include monitoring and that incorporation of the HMP into the Portland Plan would be necessary.
- Adoption of the plan after approval from State and FEMA

Sam Adams, Mayor
Carmen Merlo, Director
1001 SW 5th Avenue, Suite 650
Portland, Oregon 97204
Phone: 503-823-4375
Fax: 503-823-3903
TDD: 503-823-6868
www.portlandonline.com/oem

-Agenda-

Hazard Mitigation Plan Update – Planning Team Meeting #2
October 12, 2009 – 10:00 AM-12:00PM
POEM Conference Room – Room 650
Congress Center – 1001 SW 5th Ave.

1. Introduction – Dautis Pearson/Patty Rueter **5 minutes**

- Meeting objectives:
  - Review, edit, and approve new Goals
  - Review existing mitigation actions' status and comments
  - Approve "ongoing" mitigation actions to carry forward
  - Review, edit and approve newly considered mitigation actions for 2009 NHMP

2. Review, Edit, And Approve New Goals **10 minutes**

- Edit goals to best meet the City's needs.

3. Review Existing Mitigation Actions' Status and Comments **30 minutes**

- Each hazard team lead: comment on any status change that differs from the new "Mitigation Action Item – Status" document.

4. Indentify, Consider, and Select "New" Mitigation Action's for Each Hazard **30 minutes**

- Each hazard team lead: report on their top mitigation actions and why they were chosen.
- Each hazard team lead: ensure new actions have responsible entities, timelines, and priority identified.

5. – Prioritize Mitigation Actions – All **40 minutes**

- Reach consensus on mitigation action item priorities.

6. – Review Items for Next Planning Meeting – All **5 minutes**

- Next steps and project schedule
- Final Planning Team Meeting on October 30, 2009 – Focuses on remaining data gaps.

Planning Meeting 2 minutes

Natural Hazard Mitigation Plan Update
Meeting #2 October 12, 2009

NAME	BUREAU	PHONE CONTACT	HAZARD AREA
Brandon Davis	BES	32625	Earthquake
Gregory Drechsler	PWB	37486	
Perry Hopkins	PWB	37074	
Dan Moeller	PP&R	34474	
Jamaal Folsom	PWB	37155	Multi-
Dautis Pearson	URS	478-7663	
Patty Rueter	POEM	33809	All
Lisa Peffer	PSU	282-6521	All
Tricia Sears	BPS	31174	Landslides etc
Mathew Silva	PFB	793-0260	Fire
Ali Young	BES	35781	Flood

Meeting #2 October 12, 2009

Meeting Minutes

Introductions and discussed overall objectives for the meeting was to review, edit and approve existing goals and mitigation actions and to consider any new actions.

- New water bureau participates. URS provide a spreadsheet with all past and potential hazards with a list of the goals of the previous plan to work from.

Review, Edit, and Approve New Goals

- Patty discussed the existing goals and agreed that all were still applicable. She directed the group to review outside of the meeting and comment or add to the goals.

Review Existing Mitigation Actions / Status and comments

- The group reviewed line by line the existing actions and made recommendations and established data gaps.
    - Additional information is required from parks/recreation, water, landslides, and planning department. Schedule to receive information from the team within the following week to update the table and incorporate into the plan.
    - Each of the participates did not get a chance to review the information and spreadsheet.

Identify, Consider, and Select "new" Mitigation actions for each hazard

- Team member selected additional hazards including erosion, volcanoes, and invasive species
- Team decided to wait on inclusion of these until further investigation into whether they were stand alone or could be a part of other hazards
- Each Team lead needed to decide who would be responsible for each action item

Prioritize Mitigation Action

- We did not get to this item, suggested that each lead would review and prioritize and report out

Review Items for next Planning Meeting

- Update information from all leads by the end of the week
- Review goals and provide edits at the end of the week
- Prioritize within your discipline
- Define roles and responsibilities
- Next Planning meeting will be minimized with a review of information that will be sent from each task lead.

Schedule commitments

Sam Adams, Mayor
Carmen Merlo, Director
1001 SW 5th Avenue, Suite 650
Portland, Oregon 97204
Phone: 503-823-4375
Fax: 503-823-3903
TDD: 503-823-3867
www.portlandoregon.gov/oem

-Agenda-

Hazard Mitigation Plan Update – Planning Team Meeting #3
November 2, 2009 – 10:00PM-12:00PM
URS Corporation

1. – Information Needs, Where are the Gaps – All

2. – Public Scoping, Have we met the need?- All

3. – Schedule, can we meet the December 31 deadline - All

4. – Implication of missing the deadline – Scott and Laura

Attendance:

Patty Rueter – POEM PM
Dautis Pearson – URS PM
Amy Lewis – URS DPM
Scott Simmons – URS Project Lead
Laura Young – URS PIM

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1001 SW 5th Avenue, Suite 650
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Fax: 503-823-3903
TDD: 503-823-6868
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-Agenda-

Hazard Mitigation Plan Update – Planning Team Meeting #3
November 2, 2009 – 10:00PM-12:00PM
URS Corporation

1. – Information Needs, Where are the Gaps – All

2. – Public Scoping, Have we met the need?- All

3. – Schedule, can we meet the December 31 deadline - All

4. – Implication of missing the deadline – Scott and Laura

Attendance:

Patty Rueter – POEM PM
Dautis Pearson – URS PM
Amy Lewis – URS DPM
Scott Simmons – URS Project Lead
Laura Young – URS PIM

PORTLAND OEM
BUREAU OF EMERGENCY MANAGEMENT

Sam Adams, Mayor
Carmen Merlo, Director
1001 SW 5th Avenue Suite 650
Portland, Oregon 97204
Phone: 503-823-4375
Fax: 503-823-3903
TDD: 503-823-6868
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-Agenda-

Hazard Mitigation Plan Update – Planning Team Meeting #4
November 23, 2009 – 10:00PM-12:00PM
URS Corporation

1. – Greetings and Introductions

2. – Identify and review the sharepoint site access and process for review of the document. Is there another media that would work better?

3. – City-wide prioritization. What are the top actions that we want to promote city-wide?

4. – Schedule for completion

Attendance:

Mark Wilson – Parks and Recreation
Tricia Sears – Planning Services
Barbara Agnon – Parks and Recreation
Matthew Silva – Fire
Maggie Skenderian – Environmental Services
Perry Hopkins – Environmental Services
Steve Yates – Transportation
Dautis Pearson – URS Corp.

Natural Hazard Mitigation Plan Update
Meeting #4 November 23, 2009

NAME	BUREAU	PHONE CONTACT	HAZARD AREA
Dautis Pearson	URS	503-478-7663	
Steve Yates	PBOT	503-823-7573	
Perry W Hopkins	Water	503-823-7076	
Maggie Skendarian	BES	503-823-5334	
Mathew Silva	Fire	503-823-5478	
Barbara Aguon	PP&R	503-823-5478	
Tricia Sears	BPS	503-823-1174	
Mark G. Wilson	PP&R	503-823-6736	

Meeting #4 November 23, 2009

Meeting Notes:

1. Introductions were concluded and a brief overview of what needed to be accomplished was presented by Patty Rueter.

2. An overview of the sharepoint site including access and process for review of documents was conducted by POEM representatives. It was decided that all would work in the context of the sharepoint so that comments could be consolidated. CD were also made available. Review will be completed by Monday December 7, 2009.

3. City-wide prioritization was completed and reviewed by the team. The action items were review and scored based on priority, number of hazards they overlapped, number of goals they met, and capability of completing (list is attached).

4. Reviewed the schedule for completion:
    a. Submit comments by December 7, 2009
    b. Submit to State by December 14, 2009
    c. City adopts February 1, 2010

Meeting Action Items:

- 21 - ID Repetitive loss infrastructure structures
- 22 - Acquire, buyout/demolish hazard prone
- 24 – Incorporate building ordinances commensurate with building codes
- 25 – Update infrastructure master plan and system vulnerability assessment and sewer failure response plan.
- 26 – Develop with side ops Center
- 27 – Promote 09 climate action plan

E.1 BENEFIT COST ANALYSIS GUIDELINE

Hazard mitigation projects are specifically aimed at reducing or eliminating future damages. Although hazard mitigation projects may sometimes be implemented in conjunction with the repair of damages from a declared disaster, the focus of hazard mitigation projects is on strengthening, elevating, relocating, or otherwise improving buildings, infrastructure, or other facilities to enhance their ability to withstand the damaging impacts of future disasters. In some cases, hazard mitigation projects may also include training or public-education programs if such programs can be demonstrated to reduce future expected damages.

A Benefit-Cost Analysis (BCA) provides an estimate of the "benefits" and "costs" of a proposed hazard mitigation project. The benefits considered are avoided future damages and losses that are expected to accrue as a result of the mitigation project. In other words, benefits are the reduction in expected future damages and losses (i.e., the difference in expected future damages before and after the mitigation project). The costs considered are those necessary to implement the specific mitigation project under evaluation. Costs are based on similar completed engineering projects. Benefits, however, must be estimated probabilistically because they depend on the improved performance of the building or facility in future hazard events, the timing and severity of which must be estimated probabilistically.

All Benefit-Costs must be:

- Credible and well documented
- Prepared in accordance with accepted BCA practices
- Cost-effective (BCR $\geq$ 1.0)

General Data Requirements:

- All data entries (other than Federal Emergency Management Agency [FEMA] standard or default values) MUST be documented in the application.
- Data MUST be from a credible source.
- Provide complete copies of reports and engineering analyses.
- Detailed cost estimate.
- Identify the hazard (flood, wind, seismic, etc.).
- Discuss how the proposed measure will mitigate against future damages.
- Document the Project Useful Life.
- Document the proposed Level of Protection.
- The Very Limited Data (VLD) BCA module cannot be used to support cost-effectiveness (screening purposes only).
- Alternative BCA software MUST be approved in writing by FEMA HQ and the Region prior to submittal of the application.

Damage and Benefit Data

- Well documented for each damage event.
- Include estimated frequency and method of determination per damage event.
- Data used in place of FEMA standard or default values MUST be documented and justified.
- The Level of Protection MUST be documented and readily apparent.
- When using the Limited Data (LD) BCA module, users cannot extrapolate data for higher frequency events for unknown lower frequency events.

Building Data

- Should include FEMA Elevation Certificates for elevation projects or projects using First Floor Elevations (FFEs).
- Include data for building type (tax records or photos).
- Contents claims that exceed 30 percent of building replacement value (BRV) MUST be fully documented.
- Method for determining BRVs MUST be documented. BRVs based on tax records MUST include the multiplier from the County Tax Assessor.
- Identify the amount of damage that will result in demolition of the structure (FEMA standard is 50 percent of pre-damage structure value).
- Include the site location (i.e., miles inland) for the Hurricane module.

Use Correct Occupancy Data

- Design occupancy for Hurricane shelter portion of Tornado module.
- Average occupancy per hour for the Tornado shelter portion of the Tornado module.
- Average occupancy for Seismic modules.

Questions to Be Answered

- Has the level of risk been identified?
- Are all hazards identified?
- Is the BCA fully documented and accompanied by technical support data?
- Will residual risk occur after the mitigation project is implemented?

Common Shortcomings

- Incomplete documentation.
- Inconsistencies among data in the application, BCA module runs and the technical support data.
- Lack of technical support data.

- Lack of a detailed cost estimate.
- Use of discount rate other than FEMA-required amount of 7 percent.
- Overriding FEMA default values without providing documentation and justification.
- Lack of information on building type, size, number of stories and value.
- Lack of documentation and credibility for FFEs.
- Use of incorrect Project Useful Life (not every mitigation measure = 100 years).

E.2 FEDERAL RESOURCES

The Federal government requires local governments to have a hazard mitigation plan in place to be eligible for mitigation funding opportunities through FEMA such as the UHMA Programs and the HMGP. The Mitigation Technical Assistance Programs available to local governments are a valuable resource. FEMA may provide temporary housing assistance through rental assistance, mobile homes, furniture rental, mortgage assistance and emergency home repairs. The Disaster Preparedness Improvement Grant also promotes educational opportunities with respect to hazard awareness and mitigation.

Bureau of Reclamation. The mission of the Bureau of Reclamation is to manage, develop and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

FEMA, through its Emergency Management Institute, offers training in many aspects of emergency management, including hazard mitigation. FEMA has also developed a large number of documents that address implementing hazard mitigation at the local level. Five key resource documents are available from FEMA Publication Warehouse (1-800-480-2520) and are briefly described here:

- **How-to Guides.** FEMA has developed a series of how-to guides to assist states, communities and tribes in enhancing their hazard mitigation planning capabilities. The first four guides describe the four major phases of hazard mitigation planning. The last five how-to guides address special topics that arise in hazard mitigation planning such as conducting cost-benefit analysis and preparing multi-jurisdictional plans. The use of worksheets, checklists and tables make these guides a practical source of guidance to address all stages of the hazard mitigation planning process. They also include special tips on meeting DMA 2000 requirements (http://www.fema.gov/fima/planhowto.shtm).
- ***Mitigation Resources for Success*** **compact disc (CD)** (FEMA 372, 2001). This CD contains a wealth of information about mitigation and is useful for state and local government planners and other stakeholders in the mitigation process. It provides mitigation case studies, success stories, information about Federal mitigation programs, suggestions for mitigation measures to homes and businesses, appropriate relevant mitigation publications and contact information (http://www.fema.gov/pdf/library/poster_fnl2.pdf).

- ***The Emergency Management Guide for Business and Industry*** (FEMA 141, 1993). This guide provides a step-by-step approach to emergency management planning, response and recovery. It also details a planning process that businesses can follow to better prepare for a wide range of hazards and emergency events. This effort can enhance a business's ability to recover from financial losses, loss of market share, damages to equipment and product or business interruptions. This guide could be of great assistance to a community's industries and businesses located in hazard prone areas (http://www.fema.gov/pdf/business/guide/bizindst.pdf).
- **NFIP.** NFIP provides Flood insurance to citizens in communities that adopt and implement NFIP siting and building standards. The standards are applied to development that occurs within a delineated floodplain, a drainage hazard area, an area subject to inundation during a base flood event and properties within 250 ft of a floodplain boundary. These areas are depicted on federal Flood Insurance Rate Maps that are available through the City of Beaverton. Oregon's Department of Land Conservation and Development is the state's NFIP-coordinating agency.

US Department of Agriculture. Assistance provided includes: Emergency Conservation Program, Non-Insured Assistance, Emergency Watershed Protection, Rural Housing Service, Rural Utilities Service and Rural Business and Cooperative Service.

- **NRCS.** NRCS provides a suite of federal programs designed to assist state and local governments and landowners in mitigating the impacts of flood events. The Watershed Surveys and Planning Program and the Small Watershed Program provide technical and financial assistance to help participants solve natural resource and related economic problems on a watershed basis. The Wetlands Reserve Program and the Flood Risk Reduction Program provide financial incentives to landowners to put aside land that is either a wetland resource or that experiences frequent flooding. The Emergency Watershed Protection Program (EWP) provides technical and financial assistance for clearing debris from clogged waterways, restoring vegetation and stabilizing riverbanks. The measures taken under EWP must be environmentally and economically sound and must generally benefit more that one property.

US Department of Energy, Office of Energy Efficiency and Renewable Energy, Weatherization Assistance Program. This program minimizes the adverse effects of high energy costs on low-income, elderly and handicapped citizens through client education activities and weatherization services such as an all-around safety check of major energy systems, including heating system modifications and insulation checks.

US Department of Health and Human Services, Administration of Children & Families, Administration for Native Americans (ANA). The ANA awards funds through grants to American Indians, Native Americans, Native Alaskans, Native Hawaiians and Pacific Islanders. These grants are awarded to individual organizations that successfully apply for discretionary funds. ANA publishes in the Federal Register an

announcement of funds available, the primary areas of focus, review criteria and the method of application. (http://www.acf.hhs.gov/programs/ana/)

US Department of Housing and Urban Development (HUD), Office of Homes and Communities, Section 108 Loan Guarantee Programs. This program provides loan guarantees as security for Federal loans for acquisition, rehabilitation, relocation, clearance, site preparation, special economic development activities and construction of certain public facilities and housing.

HUD, Community Development Block Grants. Provides grant assistance and technical assistance to aid communities in planning activities that address issues detrimental to the health and safety of local residents, such as housing rehabilitation, public services, community facilities and infrastructure improvements that would primarily benefit low-and moderate-income persons.

US Department of Labor, Employment and Training Administration, Disaster Unemployment Assistance. Provides weekly unemployment subsistence grants for those who become unemployed because of a major disaster or emergency. Applicants must have exhausted all benefits for which they would normally be eligible.

Federal Financial Institutions. Member banks of Federal Deposit Insurance Corporation, Financial Reporting Standards or Federal Home Loan Bank Board may be permitted to waive early withdrawal penalties for Certificates of Deposit and Individual Retirement Accounts.

Internal Revenue Service, Tax Relief. Provides extensions to current year's tax return, allows deductions for disaster losses and allows amendment of previous tax returns to reflect loss back to three years.

National Weather Service, Portland Bureau. The NWS provides flood watches, warnings and informational statements for rivers in the City. The NWS Portland office provides river level information online and by phone.

National Earthquake Hazards Reduction Program (NEHRP). NEHRP's mission includes improved understanding, characterization and prediction of hazards and vulnerabilities; improved model building codes and land use practices; risk reduction through post-earthquake investigations and education; development and improvement of design and construction techniques; improved mitigation capacity; and accelerated application of research results. FEMA is the lead agency of the program and assigns several planning, coordinating and reporting responsibilities.

National Earthquake Loss Reduction Program (NEP). NEP was formed as a result of the report "Strategy for National Earthquake Loss Reduction" prepared by the Office of Science and Technology Policy in April 1996 which stated, the NEP "aims to focus scarce research and development dollars on the most effective means for saving lives and property and limiting the social disruptions from earthquakes, coordinate federal

earthquake mitigation research and development and emergency planning in a number of agencies beyond those in NEHRP to avoid duplication and ensure focus on priority goals and cooperate with the private sector and with state and local jurisdictions to apply effective mitigation strategies and measures." The NEP does not replace NEHRP but encompasses a wider range of earthquake hazard reduction activities than those supported by the NEHRP agencies and provides a framework within which these activities can be more effectively coordinated.

The National Earthquake Technical Assistance Program (NETAP). The NETAP is a technical assistance program created to provide ad hoc, short-term architectural and engineering support to state/local communities as they are related to earthquake mitigation. The program was designed to enhance the state/local communities' ability to become more resistant to seismic hazards. This assistance cannot be used for actions that are covered under the State's/Territories Performance Partnership Agreement. This program assists in carrying out the statutory authorities of the National Earthquake Hazards Reduction Act of 1977, as amended.

National Seismic Hazard Mapping Project. National maps of the earthquake shaking hazard in the US have been produced since 1948. Scientists revise these maps as new earthquake studies improve their understanding of this hazard. After thorough review, professional organizations of engineers in turn update the seismic-risk maps and seismic design provisions contained in building codes. More than 20,000 cities, counties and local government agencies use building codes, such as the International Building Code, to help establish the construction requirements necessary to preserve public health and safety in earthquakes. The 1996 USGS shaking-hazard maps for the US are based on current information about the rate at which earthquakes occur in different areas and on how far strong shaking extends from quake sources.

United States Army Corp of Engineers (USACE). The USACE Civil Works Branches study potential water resource projects throughout the nation. These studies analyze and solve water resource issues of concern to the local communities. These issues may involve navigational improvements, flood control, or ecosystem restoration. The agency also tracks flood hazard data on floodplains or the sea coast. These data help local communities assess their flood risks to help them prepare for potential future floods.

United States Geological Survey (USGS). The USGS website provides current stream flow conditions at USGS gauging stations in Oregon and throughout the Pacific Northwest. The Oregon USGS office is responsible for water-resources investigations for Oregon and part of southern Washington. Their office cooperates with more than 40 local, state and federal agencies in Oregon. Cooperative activities include water-resources data collection and interpretive water-availability and water-quality studies.
USGS, National Landslide Information Center (NLIC). The NLIC website provides good information on the programs and resources regarding landslides. The page includes information on the National Landslide Hazards Program Information Center, a bibliography, publications and current projects. USGS scientists are working to reduce

long-term losses and casualties from landslide hazards through better understanding of the causes and mechanisms of ground failure both nationally and worldwide.

US Small Business Administration (SBA). May provide low-interest disaster loans to individuals and businesses that have suffered a loss due to a disaster. Requests for SBA loan assistance should be submitted to OEM.

E.3 STATE RESOURCES (OREGON 2009)

Oregon Emergency Management (OEM). OEM administers FEMA's Hazard Mitigation Grant Program to provide post-disaster monies for acquisition, elevation, relocation and demolition of structures located in the floodplain. OEM also administers FEMA's Flood Mitigation Assistance Program. This program provides assistance for NFIP-insured structures only. OEM also helps local jurisdictions to develop hazard mitigation plans. OEM is heavily involved in flood damage assessment and works mainly with disaster recovery and hazard mitigation programs. OEM provides training for local governments through workshops on recovery and mitigation. OEM also helps implement and manage federal disaster recovery programs.

Oregon Department of Consumer and Business Services-Building Codes Division (BCD). The BCD sets statewide standards for design, construction and alteration of buildings that include resistance to seismic forces. BCD is active on several earthquake committees and funds construction-related continuing education programs. BCD registers persons qualified to inspect buildings as safe or unsafe to occupy following an earthquake and works with OEM to assign inspection teams where they are needed.

Oregon Economic and Community Development Department (OECDD) CDBG. These grants are made available to communities in the State of Oregon, usually via OECDD with funding provided by HUD. While these grants originate with a federal agency, the funding is usually considered non-federal for matching grant purposes (i.e., CDBG can usually be utilized as non-federal match to other federal funding sources).

Oregon Department of Environmental Quality (DEQ). DEQ is responsible for protecting and enhancing Oregon's water and air quality, for cleaning up spills and releases of hazardous materials, for managing the proper disposal of hazardous and solid wastes and for enforcing Oregon's environmental laws.

DEQ staff use a combination of technical assistance, inspections and permitting to help public and private facilities and citizens understand and comply with state and federal environmental regulations.

The DEQ staff consists of scientists, engineers, technicians, administrators and environmental specialists. The agency's headquarters are in Portland with regional administrative offices in Bend, Eugene and Portland; and field offices in Coos Bay,

Grants Pass, Hermiston, Medford, Pendleton, Salem and The Dalles. DEQ operates a modern pollution-control laboratory in Hillsboro.

Oregon Department of Fish and Wildlife (ODFW). ODFW's mission is to protect and enhance Oregon's fish and wildlife and their habitats for use and enjoyment by present and future generations. ODFW regulates stream activity and engages in stream enhancement activities.

Oregon Department of Human Services (ODHS). The ODHS mission is to make it possible for people to lead lives that are independent, healthy and safe. To do this, ODHS employs approximately 9,800 individuals throughout the state who provide crucial safety net services to persons facing job loss, health problems and other uncertainties. ODHS also ensures Oregonians have clean drinking water, safe food and an effective emergency trauma services system.

Department of Land Conservation and Development (DLCD). DLCD administers the State's Land Use Planning Program. The program is based on 19 Statewide Planning Goals, including Goal 7, related to flood and other natural hazards. DLCD serves as the federally designated agency to coordinate floodplain management in Oregon. They also conduct various landslide related mitigation activities. In order to help local governments address natural hazards effectively, DLCD provides technical assistance and conducts workshops, reviews local land use plan amendments and works interactively with other agencies.

Oregon Division of State Lands (DSL). DSL is a regulatory agency responsible for administration of Oregon's Removal-Fill Law. This law is intended to protect, conserve and make the best use of the state's water resources. It generally requires a permit from DSL to remove, fill, or alter more than 50 cubic yards of material within the bed or banks of state waters. Exceptions are in state scenic waterways and areas that are designated essential salmon habitat; in these areas, a permit is required for all in-stream activity regardless of volume. DSL and the USACE may issue these permits jointly.

Oregon Department of Transportation (ODOT). ODOT provide a safe, efficient transportation system that supports economic opportunity and livable communities for Oregonians. ODOT develops programs related to Oregon's system of highways, roads and bridges; railways; public transportation services; transportation safety programs; driver and vehicle licensing; and motor carrier regulation.

In addition, ODOT and OEM coordinate buyout projects to ensure that there are no potential right-of-way conflicts with future use of land for bridge and highway projects and collaborate on earthquake mitigation.

Additionally, ODOT uses its resources to identify the hazard, plan and initiate mitigation activities to meet the transportation needs of Oregonians and make Oregon a better place to live and work. ODOT budgets for the temporary replacement bridges and

materials necessary to make the multi-model transportation system operational following a natural disaster.

Oregon Parks and Recreation Department (OPRD). OPRD operates Oregon's state parks through a headquarters staff in Salem and field regions. It is also responsible for Oregon's Recreation Trails, the Ocean Shores Recreation Area, Scenic Waterways and the Willamette River Greenway. OPRD's Heritage Programs Division, which includes the State Historic Preservation Office, Heritage Commission and the Oregon Commission on Historic Cemeteries, operates a number of cultural and historic preservation programs. Oregon State Parks has given grant money to nearly every city in Oregon to purchase land and build or upgrade community parks. For additional information go to: http://www.oregon.gov/OPRD/GRANTS/.

The Oregon Partnership for Disaster Resilience. In partnership with OEM, the Oregon Partnership for Disaster Resilience has established a statewide Pre-Disaster Mitigation planning program that systematically provides both funding and technical assistance to local governments to develop and update existing local natural hazard mitigation plans. For additional information go to: http://www.oregonshowcase.org/mitigation/planning

Oregon Department of Forestry (ODF). The mission of the ODF is to serve the people of Oregon through the protection, management and promotion of a healthy forest environment, which will enhance Oregon's livability and economy for today and tomorrow. ODF regulates forest operations to reduce the risk of serious injury or death from rapidly moving landslides related to forest operations and assists local governments in the siting review of permanent dwellings on and adjacent to forestlands in further review areas.

Department of Geology and Mineral Industries (DOGAMI). DOGAMI is an important agency for landslide mitigation activities in Oregon. Some key functions of DOGAMI are development of geologic data, development of maps and regulation of mining and drilling for geological resources. The agency also provides technical resources for communities and provides public education on geologic hazards. DOGAMI provides data and geologic information to local, state and federal natural resource agencies, industry and private groups.

Oregon Water Resources Department (WRD). The WRD's mission is to serve the public by practicing and promoting wise long-term water management. The WRD provides services through 19 Watermaster Offices throughout the State. In addition, five regional offices provide services based on geographic regions. The Department's main administration is performed from the central office in Salem.

Oregon Watershed Enhancement Board (OWEB). OWEB was created by the 1987 Oregon Legislature. OWEB is charged with supporting implementation of *The Oregon Plan for Salmon and Watersheds*, which includes the Oregon Coastal Salmon Restoration

Initiative (OCSRI) and the Healthy Streams Partnership. For additional information go to: http://www.oweb.state.or.us/

E.4 REGIONAL RESOURCES (OREGON 2009)

Metropolitan Service District (Metro). Metro manages the urban growth boundary and developed the 2040 growth concept. Metro provides land-use planning services and provides maps and data to businesses, local government and citizens. Metro helps residents and governments protect fish and wildlife habitat. Metro's transportation planning section develops the regional.

Regional Emergency Management Group/Regional Emergency Management Technical Committee (REMG/REMTEC). Emergency Management professionals coordinate regional resources and resolve regional issues through the "hands on" technical committee which proposes and reports to the "public official level" regional emergency management group. Recently, the committee has developed maps for regional emergency response routes.

Multnomah County Emergency Management. Responsible for the coordination of county programs such as Public Health, County Roads, Animal Control, libraries, county jails and the cities within the unincorporated areas of the county.

E.5 CITY RESOURCES (OREGON 2009)

Portland Office of Emergency Management (POEM). POEM is responsible for the coordination of plan development, training, exercise and equipment procurement and/or distribution. Its primary responsibility is the readiness of the Emergency Coordination Center for the City of Portland. Emergency Management is responsible for updating plans as codified by Title 15 of the City Code and in alignment with federal and state standards.

Portland Bureau of Development Services (BDS). PBDS has geotechnical engineering staff to review all building permits for new development in landslide-prone areas. As part of these building permit reviews, PBDS can require geotechnical engineering or engineering geology reports to address landslide concerns. In addition, the Zoning Code requires geotechnical engineering/engineering geology reports to be submitted for land use review applications in some situations. In a land use review application, the land use planning staff and the geotechnical staff review the submitted reports to ensure that applicable approval criteria are met.

Portland Bureau of Planning and Sustainability (BPS). *The City Comprehensive Plan* includes policies that relate to landslide hazards both implicitly and explicitly. These include: Natural Hazards, Uplands Protection and Slope Protection and Drainage. Sustainable Development's Multifamily Assistance Program works with property owners and managers to market the benefits of energy efficiency and simplify the process of

weatherizing rental properties. They provides technical information on insulation and high-efficiency windows, maintains a list of qualified contractors and assists property owners in applying for rebates, state tax credits and low-interest financing that may be available for energy-efficiency projects. The resulting energy-efficiency projects increase the value of the property, reduce tenants' energy bills and improve indoor comfort. During an extreme winter storm event, residents in weatherized properties have additional protection against cold if there is an electricity blackout, since most local multifamily properties have electric space heat.

Portland Parks & Recreation (PP&R). The City Nature Division of Portland Parks and Recreation manages approximately 7400 acres of City park natural area. *The Park Natural Area Vegetation Surveys* (2004-2006) and the *Wildfire Risk Assessment & Gap Analysis Plan* (2009) identify flammable invasive species and potential risks to PP&R natural area parks from wildfire. The Wildfire Risk Plan states that wildfire hazard is currently low, but makes several important observations:

1. Flammable invasive species are the primary hazardous fuels sources beneath utility ROWS and at the wildland urban interface with urban development.
2. Hardwood stands in the park are currently functioning as shaded fuel breaks that generally keep ground fire from reaching the tree canopy. However, these conditions will change over time due to forest succession to a more fire susceptible conifer dominated tree stand.

Therefore, wildfire risk should be reassessed periodically for change on the same 10-year schedule recommended for monitoring vegetative change in the Park. The Wildfire Risk Plan also recommends that the city form a Wildfire Technical group to address coordination, training and vegetation management issues.

Bureau of Transportation (PBOT). PBOT's importance in mitigation has been very under estimated. They coordinate the clearance of roads after a disaster, keep the street network free from cracks or sluffs and maintain knowledge of the below and above surface infrastructure. If areas of greatest risk are identified prior to a disaster, mitigation efforts can be planned or response routes changed to accommodate the lack of thoroughfare due to the landslide effects.

Portland Bureau of Environmental Services (BES). BES's work for ecosystem restoration and stabilization has many similarities to natural hazard mitigation. The natural systems are what make Portland and the region livable. With the increased development in the Portland Metro area, our natural habitat is at risk and being depleted. Ecological protection and mitigative actions go hand in hand to strengthen the endangered terrain, habitat and wildlife.

Portland Water Bureau (Water). The Water Bureau is an active partner in landslide mitigation. Since a 1996 report indicated that the Water Bureau should, "Continue to mitigate landslide hazards to the conduits from Bull Run", mitigation projects have successfully protected the water pipes and storage systems ensuring continued availability.

Portland Fire & Rescue (PF&R). The Portland Bureau of Fire & Rescue is the responding agency in charge of plan development for the coordination of an earthquake event. With 27 stations across the Portland area and many more regional partners in the fire service, the Bureau of Fire and Rescue lends a trained force that has familiarized itself with the buildings' plans, the street network and the neighborhood of their fire management areas. With this knowledge they know where vulnerable people live and can work with the community to save lives and property expediently.

Portland Office of Neighborhood Involvement (ONI). ONI is responsible for increasing the number and diversity of people who are involved and volunteer in their communities and neighborhoods. They help strengthen and build capacity, increase the publics impact on public decisions and provide tools and resources to improve neighborhood livability and safety. ONI operates the Information and Referral phone bank that allows easy access by the community to correct contacts within the City bureaus.

Landslide Coordination Committee. The Landslide Coordination Committee was established after the 1996 landslides. It consists of staff representing the Bureau of Development Services, the Portland Office of Transportation, the Bureau of Maintenance, the Bureau of Environmental Services, the Parks and Recreation Bureau, the Water Bureau and Risk Management. It meets primarily in the fall through spring months to review landslide occurrences within the City, communicate details of the landslide event and coordinate review, permitting and mitigation activities. The group has developed a procedure for quickly alerting members by email with pertinent information on a landslide occurrence so that each bureau can determine actions that need to be taken. The group has also developed a procedure for processing landslide repair projects in environmental zones.

Capital Improvement Plan. The City of Portland's Capital Improvements Program (CIP) is a dynamic document that is reviewed by a CIP development team who prioritizes projects to be scheduled into a five-year citywide projected budget. Each bureau submits their projects after reviewing them through weighted criteria. Some landslide mitigation projects might be considered as part of the capital improvement plan.

Wildfire Technical Committee. This group was formed in 2009 at the request of Portland City Council and is composed of City and Multnomah County agencies. The committee coordinates the implementation of the wildfire mitigation actions across the city. Priority actions include vegetation management policy and code, mapping, education and training and funding.

Portland State University, Department of Geology. Portland State University conducts research and prepares inventories and reports for communities throughout Oregon. Research and projects conducted through the Department of Geology at Portland State University include an inventory of landslides for the Portland metropolitan region after the 1996 and 1997 floods and a subsequent susceptibility report and planning document for Metro in Portland. The City of Portland has existing staff, land and financial management tools to implement hazard mitigation activities. The resources available in these areas have been assessed by the hazard mitigation Steering Committee and are summarized in Table E-5a and E-5b below.

Table E-5a City of Portland Staff Resources

Staff/Personnel Resources	Y/N	Department/Agency and Position
Planner and/or engineer with knowledge of land development and land management practices	Yes	BP&S – Planner
Engineer and/or professional trained in construction practices related to buildings and/or infrastructure	Yes	BP&S - Engineer
Planner and/or engineer with an understanding of natural and/or human-caused hazards	Yes	POEM – Planner
Floodplain Manager	Yes	BP&S – Floodplain Manager
Staff with education or expertise to assess the jurisdiction's vulnerability to hazards	Yes	Emergency Management Steering Committee – key infrastructure bureaus
Personnel skilled in GIS and/or HAZUS	Yes	BP&S , Bureaus with GIS technicians
Scientists familiar with the hazards of the jurisdiction	Yes	DOGAMI, USGS, PSU Geology Dept., NWS
Emergency Manager	Yes	POEM - Director
Grant writers	Yes	Water – Engineer; BES – Prog. Mgr.; POEM – Planner; BP&S - Planner

Table E-5b City of Portland Financial Resources for Hazard Mitigation

Financial Resources	Effect on Hazard Mitigation
General funds	Yes
Capital Improvement Projects Funding	DK
Fees for water, sewer, gas, or electric service	Yes
Impact fees for homebuyers or developers for new developments/homes	DK
Authority to levy taxes for specific purposes	Yes, with voter approval
Incur debt through general obligation bonds	Yes, with voter approval
Incur debt through special tax	Yes, with voter approval
Incur debt through revenue bonds	Yes, with voter approval or With Board of County Commissioners Approval
Incur debt through private activity bonds	Yes, with voter approval or With Board of County Commissioners Approval
Hazard Mitigation Grant Program (HMGP)	FEMA funding which is available to local eligible communities after a Presidentially-declared disaster. It can be used to fund both pre- and post-disaster mitigation plans and projects.
Pre-Disaster Mitigation (PDM) grant program	FEMA funding which is available on an annual basis. This grant can only be used to fund pre-disaster mitigation plans and projects.
Flood Mitigation Assistance (FMA) grant program	FEMA funding which is available on an annual basis. This grant can be used to mitigate and protect repetitively flooded structures and infrastructure.
United States Fire Administration (USFA) Grants	The purpose of these grants is to assist state, regional, national or local organizations to address fire prevention and safety. The primary goal is to reach high-risk target groups including children, seniors and firefighters.
Fire Mitigation Fees	Finance future fire protection facilities and fire capital expenditures required because of new development within Special Districts.

Based on the above information, the City has the capability to develop, manage and complete mitigation projects using appropriate and available resources and expertise to fulfill federal grant requirements.

The City has the capability to hire or utilize existing resources to manage their hazard mitigation planning goals, initiatives and plan implementation and management requirements.

E.6 OTHER FUNDING SOURCES AND RESOURCES

The following provide focused access to valuable planning resources for communities interested in sustainable development activities.

Cascadia Region Earthquake Workgroup (CREW). CREW provides information on regional earthquake hazards, facts and mitigation strategies for the home and business office. CREW is a coalition of private and public representatives working together to improve the ability of Cascadia Region communities to reduce the effects of earthquake events. Members are from Oregon, Washington, California and British Columbia.

American Planning Association. A non-profit professional association that serves as a resource for planners, elected officials and citizens concerned with planning and growth initiatives. http://www.planning.org

Institute for Business and Home Safety. An initiative of the insurance industry to reduce deaths, injuries, property damage, economic losses and human suffering caused by natural disasters. http://www.ibhs.org/ibhs2

American Red Cross. Provides for the critical needs of individuals such as food, clothing, shelter and supplemental medical needs. Provides recovery needs such as furniture, home repair, home purchasing, essential tools and some bill payment may be provided. http://www.redcross-pdx.org

Firewise, The National Wildland/Urban Interface Fire program. Firewise maintains a website designed for people who live in wildfire-prone areas, but it also can be of use to local planners and decision makers. The site offers online wildfire protection information and checklists, as well as listings of other publications, videos and conferences.

State of Washington, Department of Ecology. The Washington State Department of Ecology has a landslide website with tips for reducing risk, identifying warning signs and using hazard maps. http://www.ecy.wa.gov/programs/sea/landslides.

Western States Seismic Policy Council. A regional organization that includes representatives of the earthquake programs of 13 states (Alaska, Arizona, California, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon Utah, Washington and Wyoming), three US territories (American Samoa, Commonwealth of the Northern Mariana Islands and Guam), one Canadian Province (British Columbia) and one Canadian Territory (Yukon). The organization has primarily sought to improve public understanding of seismic risk, to improve earthquake preparedness and to provide a cooperative forum to enhance transfer of mitigation technologies at the local, state, interstate and national levels. The mission of the Council is to provide a forum to advance earthquake hazard reduction programs throughout the western region and to develop, recommend and present seismic policies and programs through information exchange, research and education.

Lindbergh Grants. Each year, The Charles A. and Anne Morrow Lindbergh Foundation presents Lindbergh Grants to individuals whose proposed research or education projects will make important contributions toward improving the quality of life by balancing technological advancements and the preservation of our environment. Awarded in amounts up to $10,580 each (a symbolic figure representing the cost of the "Spirit of St. Louis" in 1927), the Grants are made in numerous areas of special interest to Charles and Anne Lindbergh, including aviation/aerospace, agriculture, arts and humanities, biomedical research and adaptive technology, conservation of natural resources, education, exploration, health and population sciences, intercultural communication, oceanography, waste disposal management, water resource management and wildlife preservation.

F.1 MONITORING, EVALUATING AND UPDATING THE NHMP

DMA 2000 Requirements: Plan Maintenance Process - Monitoring, Evaluating and Updating the Plan

> **Requirement §201.6(c)(4)(i):** [The plan maintenance process shall include a] section describing the method and schedule of monitoring, evaluating and updating the mitigation plan within a five-year cycle.

The City developed the Emergency Management Steering Committee (EMSC) in 2005 to manage emergency management issues relevant to their bureaus and the City as a whole. The 2010 Mitigation Planning Team and the EMSC as a part of their duties, have the responsibility to monitor and evaluate the NHMP. The EMSC will assure that key bureau personnel within the City are represented in NHMP update activities. The Emergency Management Steering Committee (EMSC) is responsible for recommending prioritized post disaster mitigation action initiatives and overall annual or five year NHMP review processes for approval by the Disaster Policy Council before final approval of the City Council. The DPC consists of the Mayor, a City Commissioner, City Attorney, City Auditor and six key infrastructure and emergency management bureau directors.

Each "responsible bureau" identified in Table 5-6-1a will be responsible for implementing the Mitigation Action Plan as resources and funding allows. A POEM designee will serve as the primary point of contact and will coordinate local efforts with the EMSC and MPT to ensure the updated NHMP is monitored, evaluated and revised as stipulated in this section.

F.1.2 Review

The NHMP update was prepared as a collaborative effort among the Planning Team and will remain a collaborative process through the maintenance and progress process. All Planning Team members will be responsible for monitoring, evaluating, and tracking the progress of the mitigation action items in the NHMP.

POEM is the coordinating body for the NHMP. The Planning Team will perform any "action" oriented and plan maintenance activities. POEM is responsible for contacting Planning Team members and organizing the annual NHMP review meeting during the anniversary week of the NHMP's official FEMA approval date. The Planning Team will monitor the progress in NHMP strategy implementation, particularly the Mitigation Action Plan.

The Annual Review Worksheet, located in this Appendix, will provide the basis for possible changes in the NHMP Mitigation Action Plan. The process should focus on new or more threatening hazards, adjusting to changes to, or increases in, resource allocations and engaging additional support for NHMP implementation.

POEM will initiate the annual review two months prior to the scheduled planning meeting date to ensure that all data is assembled for discussion with the Planning Team. The findings from these reviews will be presented at the annual EMSC NHMP Plan Update Meeting. Each review, as shown on the Annual Review Worksheet, will include an evaluation of the following:

- Bureaus and other stakeholders responsible for NHMP implementation.
- Notable changes in natural hazards risks or vulnerabilities.
- Natural hazards impacts to the City and on Mitigation Action Plan initiatives. (Success or failures).
- Mitigation Action Plan progress. (Identify problems and suggest improvements as necessary).
- NHMP implementation resource adequacy.

The annual review process will include a method to determine progress toward achieving identified mitigation goals and Mitigation Action Plan activities' implementation. Each bureau administering a mitigation project will submit a Progress Report to the Planning Team. As shown in this Appendix, the report will include the current status of the mitigation project, including any project changes, implementation problems or barriers and appropriate strategies to overcome them and whether or not the project has helped achieve the appropriate NHMP identified goals.

The Planning Team will monitor and evaluate the NHMP annually to fulfill NFIP and CRS criteria and, in addition to the annual review, update the NHMP every five years to fulfill §201.6 criteria. The Planning Team will undertake the following activities to ensure that this update process starts in the third year following NHMP adoption:

- Request grants assistance from OEM to update the NHMP (this can take up to one year to obtain funding and one year to update the plan).
- Analyze and update the natural hazards risk.
- Provide a new annual review (as noted above), plus a review of the three previous annual reviews.
- Provide a detailed mitigation strategy review and revision.
- Prepare a new NHMP Mitigation Action Plan.
- Prepare a new Draft NHMP.
- Submit an updated NHMP to EMSC and the DPC for review and the City Council for approval.
- Submit the City Council approved NHMP to OEM and FEMA for approval.
- Submit the FEMA-approved plan to the City Council for adoption

Annual Review Questionnaire

PLAN SECTION	QUESTIONS	YES	NO	COMMENTS
PLANNING PROCESS	Are there internal or external organizations and agencies that have been invaluable to the planning process or to mitigation action			
	Are there procedures (e.g., meeting announcements, plan updates) that can be done more efficiently?			
	Has the Task Force undertaken any public outreach activities regarding the MHMP or implementation of mitigation actions?			
HAZARD PROFILES	Has a natural and/or human-caused disaster occurred in this reporting period?			
	Are there natural and/or human-caused hazards that have not been addressed in this HMP and should be?			
	Are additional maps or new hazard studies available? If so, what have they revealed?			
VULNERABILITY ANALYSIS	Do any new critical facilities or infrastructure need to be added to the asset lists?			
	Have there been changes in development patterns that could influence the effects of hazards or create additional risks?			
MITIGATION STRATEGY	Are there different or additional resources (financial, technical, and human) that are now available for mitigation planning within the			
	Are the goals still applicable?			
	Should new mitigation actions be added to the a community's Mitigation Action Plan?			
	Do existing mitigation actions listed in a community's Mitigation Action Plan need to be reprioritized?			
	Are the mitigation actions listed in a community's Mitigation Action Plan appropriate for available resources?			

Mitigation Action Progress Report

Progress Report Period: _____ (date) to _____ (date)

Project Title: _____ Project ID# _____

Responsible Agency: _____

Address: _____

City: _____

Contact Person: _____ Title: _____

Phone #(s): _____ email address: _____

List Supporting Agencies and Contacts:

_____

_____

Total Project Cost: _____

Anticipated Cost Overrun/Underrun: _____

Date of Project Approval: _____ Start date of the project: _____

Anticipated completion date: _____

Description of the Project (include a description of each phase, if applicable, and the time frame for completing each phase): _____

_____

_____

_____

Milestones	Complete	Projected Date of Completion

Plan Goal (s) Addressed:

Goal: _____

Indicator of Success: _____

_____

_____

_____

Project Status

☐ Project on schedule

☐ Project completed

☐ Project delayed*

*explain: _____

_____

☐ Project canceled

Project Cost Status

☐ Cost unchanged

☐ Cost overrun*

*explain: _____

_____

☐ Cost underrun*

*explain: _____

_____

Summary of progress on project for this report:

A. What was accomplished during this reporting period?

_____

_____

_____

_____

B. What obstacles, problems, or delays did you encounter, if any?

_____

_____

_____

_____

C. How was each problem resolved?

_____

_____

_____

_____

Next Steps: What is/are the next step(s) to be accomplished over the next reporting period?

Other Comments:

F.2 IMPLEMENTATION THROUGH EXISTING PLANNING MECHANISMS

DMA 2000 Requirements: Plan Maintenance Process - Incorporation into Existing Planning Mechanisms

> **Requirement §201.6(c)(4)(ii):** [The plan shall include 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.

The City addresses statewide planning goals and legislative requirements through its comprehensive land use plan, capital improvement plans, City codes and an array of non-regulatory projects and programs. The NHMP provides a series of recommendations – many of which are closely related to the goals and objectives of existing planning programs. To the extent possible, the City will incorporate the recommended mitigation action items into existing programs and procedures.

After the adoption of the NHMP, POEM will promote that the NHMP, in particular each Mitigation Action, is incorporated into existing planning mechanisms. The POEM will achieve this incorporation by undertaking the following activities.

- Ensure the identified mitigation goal is fulfilled by conducting a review of the community-specific regulatory tools to assess the integration of the mitigation strategy. These regulatory tools are identified in the following capability assessment section.
- Track implemented mitigation actions to determine their success or failure and to determine roadblocks to implantation along with identifying potential corrective actions.
- Work with appropriate community members to increase awareness of the NHMP and provide assistance in integrating the mitigation strategy (including the Mitigation Action Plan) into relevant planning mechanisms. Implementation of these requirements may require updating or amending specific planning mechanisms.

F.2.1 Incorporating NHMP Activities and Actions

This section defines whether the DPC, bureaus and agencies effectively managed the commitments implied within the 2004 NHMP.

Within the last five years the Portland Office of Emergency Management has gone through great transition. One was the decision to restructure the Disaster Policy Council. Membership changed from representatives from each bureau to representatives from key response bureaus that would be called upon to advise the Mayor in a major emergency. Therefore, the resulting job description and representation responsibilities changed their mitigation process involvement.

The majority of the obligations outlined in the 04 plan have not been completed. The responsibility of these actions will become the responsibility for the EMSC and POEM in the 2010 plan. Table F-2-1a lists promised activity commitments identified in the 2004 NHMP and their status.

Table F-2-1a 2004 NHMP Proposed Actions

("Did we do what we said we would do?")

2004 NHMP Section	2004 Activity Commitment	Status Fulfilled – F Not Fulfilled – NF	New Action Commitment
Planning Process	Hazard Mitigation Steering Committee will disband and reform as the Disaster Policy Council (DPC).	NF	Hazard Mitigation Plan monitoring and evaluation will be a part of the responsibility of the Emergency Management Steering Committee (EMSC).
	External Review Board will be created and called upon for comment, review and advice as needed.	NF	An External Review Board will be created and called upon for comment, review and advice as needed.
Risk Assessment	Planners might consider the risk assessment in the NHMP and evaluate it for inclusion in the Comprehensive Plan update.	NF	Comprehensive Plan Update has a finish date of 2015. Planning will include hazard consideration.
	DPC will be responsible for will review the risk assessment to determine if updates are necessary. (From Plan Maintenance)	NF	Hazard Analysis will be updated with the change of the Portland landscape both physical and societal. Review will be by External Review and the Planning Team.
Mitigation Strategy	DPC will engage additional stakeholders and other relevant hazard mitigation organizations and agencies to implement the identified action item.	NF	Bureau participation in the strategic direction of mitigation planning identified similarities between existing bureau specific plans and the mitigation plan. This will continue.
	Planners might consider the mitigation action items in the NHMP and evaluate them for inclusion in the Comprehensive Plan update.	NF	The Comprehensive Plan has not been updated, POEM will promote this viewpoint.
	DPC and Portland Office of Emergency Management	NF	All bureaus applying for FEMA funding will conduct a BCA as a

Table F-2-1a 2004 NHMP Proposed Actions

("Did we do what we said we would do?")

2004 NHMP Section	2004 Activity Commitment	Status Fulfilled – F Not Fulfilled – NF	New Action Commitment
	(POEM) will use FEMA-approved cost-benefit methodology as a tool for identifying and prioritizing mitigation action items when applying for federal mitigation funding.		part of the grant application. This was done by the bureaus not by DPC or POEM.
	POEM will convene a committee to review the issues surrounding grant applications and shared knowledge and/or resources.	F	Grant application committees will continue to meet if grants are attained for mitigation projects.
	In examining the feasibility of the NHMP's prioritized action items, a cost-benefit analysis will be encouraged for all structural mitigation projects.	NF	In examining the feasibility of the NHMP's prioritized action items, a cost-benefit analysis will be encouraged for all structural mitigation projects and will be promoted to be a part of the Asset Management Plan of the City and each bureau.
Plan Maintenance	DPC will review the NHMP annually and oversee the update process.	NF	The Planning Team will review the NHMP annually and POEM will oversee the update process.
	POEM and the Bureau of Planning will be jointly responsible for overseeing the plan's implementation and maintenance through the City's existing programs.	NF	POEM will be responsible for overseeing the plan's implementation and maintenance through the City's existing programs.
	Emergency Management Director will work with the DPC Chair to facilitate NHMP implementation and maintenance meetings.	NF	POEM will coordinate presentations to Bureau Managers when needed for update of implementation.
	DPC will be responsible for monitoring and evaluating	NF	EMSC will be responsible for monitoring and evaluating the

Table F-2-1a 2004 NHMP Proposed Actions

("Did we do what we said we would do?")

2004 NHMP Section	2004 Activity Commitment	Status Fulfilled – F Not Fulfilled – NF	New Action Commitment
	the progress of the mitigation strategies in the NHMP and review the mission and goals to determine their relevance to changing situations.		progress of the mitigation strategies in the NHMP. EMSC will review the mission and goals to determine their relevance to changing situations.
	Director of POEM is responsible for contacting the Committee members and organizing a plan review meeting at least annually.	NF	Planning Program Manager is responsible for contacting the Committee members and organizing a plan review meeting at least annually.
	POEM will be responsible for incorporating the changes and updates to the plan before submitting the final document to DPC and City Council for approval.	F	POEM will be responsible for incorporating the changes and updates to the plan before submitting the final document to EMSC, DPC and City Council for approval.
	DPC will convene following any declared disaster in Portland to consider the mitigation plan in light of the impacts of the event and to strategize mitigation efforts.	NF	EMSC will convene following any declared disaster in Portland to review mitigation plan in light of the impacts of the event and to strategize mitigation efforts.
Implementation into Existing Plans	DPC will work with City Bureaus to identify relevant action items from the NHMP and work to incorporate such actions into the appropriate sections of the City's Capital Improvement Programs. (From Planning Process)	NF	POEM and the Planning Team members will work with City Bureaus to identify relevant action items from the NHMP and work to incorporate such actions into the appropriate sections of the City's Capital Improvement Programs.
	After formal adoption of the NHMP, identified mitigation actions will be incorporated into the process of existing planning mechanisms at the City level as opportunities	F	After formal adoption of the NHMP, identified mitigation actions will be incorporated into the process of existing planning mechanisms at the City level as opportunities

Table F-2-1a 2004 NHMP Proposed Actions

("Did we do what we said we would do?")

2004 NHMP Section	2004 Activity Commitment	Status Fulfilled – F Not Fulfilled – NF	New Action Commitment
	arise. (From Planning Process)		arise.
	To the extent possible, the City will work to incorporate the recommended mitigation action items into existing programs and procedures. (From Mitigation Strategy)	F	To the extent possible, the City will work to incorporate the recommended mitigation action items into existing programs and procedures.
Public Involvement	Subject matter experts that had been identified by subcommittees during plan development were invited to form an External Review Board.	NF	Subject matter experts that have been identified during plan development are invited to form an External Review Board.
	POEM will convene a meeting of the External Review Board once the Steering Committee reviews a draft of the plan and approves it.	NF	POEM will convene a meeting of the External Review Board once the plan is approved by City Council.

Appendix G
Acronyms and Abbreviations

°F	degrees Fahrenheit
AFG	Assistance to Firefighters Grant
ANA	Administration for Native Americans
BCA	Benefit/Cost Analysis
BCD	Oregon Building Codes Division
BDS	Bureau of Development Services (Portland)
BF&R	Bureau of Fire and Rescue (Portland)
BEOC	Bureau of Emergency Communications (Portland)
BES	Bureau of Environmental Services (Portland)
BGS	Bureau of General Services (Portland)
BP&R	Bureau of Parks and Recreation (Portland)
BPS	Bureau of Planning and Sustainability (Portland)
CD	Compact Disc
CFR	Code of Federal Regulations
CGIS	Corporate Geographic Information System (Portland)
CIP	Capital Improvements Program
city	jurisdictional boundary of the city limits
City	City of Portland (government)
CO_2	Carbon Dioxide
CREW	Cascadia Region Earthquake Workgroup
CRS	Community Rating System
DEQ	Oregon Department of Environmental Quality
DHS	United States Department of Homeland Security
DLCD	Department of Land Conservation and Development
DMA 2000	Disaster Mitigation Act of 2000
DOGAMI	Oregon Department of Geology and Mineral Industries
DPC	Disaster Policy Council
DSL	Division of State Lands
EFSP	Emergency Food and Shelter Program
EMSC	Emergency Management Steering Committee
ENSO	El Niño/La Niña Southern Oscillation
EWP	Emergency Watershed Protection Program
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FMA	Flood Mitigation Assistance
FP&S	Fire Prevention and Safety
ft	feet
FY	Fiscal Year
g	gravity as a measure of peak ground acceleration
HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program
HR	Human Resources (Portland)
HUD	Housing and Urban Development
LiDAR	Light Detection and Ranging
LGP	Lindbergh Grant Program
M	Magnitude

MAX	Metropolitan Area Express
MC	Multnomah County
MCDD	Multnomah County Drainage District
Metro	Metropolitan Services District
MH	Multi-Hazard
MMI	Modified Mercalli Intensity scale
mph	miles per hour
NEHRP	National Earthquake Hazards Reduction Program
NEP	National Earthquake Loss Reduction Program
NETAP	National Earthquake Technical Assistance Program
NFIP	National Flood Insurance Program
NGO	Non-governmental Organization
NHMP	Natural Hazard Mitigation Plan
NLIC	National Landslide Information Center
NOAA	National Oceanic and Atmospheric Administration
NRCS	National Resource Conservation Service
NWS	National Weather Service
OMF	Office of Management and Finance (Portland)
ONI	Office of Neighborhood Involvement (ONI)
ODA	Oregon Department of Agriculture
ODF	Oregon Department of Forestry
ODFW	Oregon Department of Fish and Wildlife
ODHS	Oregon Department of Human Services
ODOT	Oregon Department of Transportation
OECDD	Oregon Economic and Community Development Department
OEM	Oregon Emergency Management
ONHW	Oregon Natural Hazard Workgroup
OPRD	Oregon Parks and Recreation Department
OCSRI	Oregon Coastal Salmon Restoration Initiative
OWEB	Oregon Watershed Enhancement Board
PDC	Portland Development Commission
PA	Public Assistance
PDE	Preliminary Determination of Epicenters
PDO	Pacific Decadal Oscillation
PDM	Pre-Disaster Mitigation
PGA	peak ground acceleration
PBOT	Portland Bureau of Transportation
PL	Public Law
POEM	Portland Office of Emergency Management
PP&R	Portland Parks and Recreation
ppm	parts per million
PW	Project Worksheet
RFC	repetitive flood claims
RL	repetitive loss
SAFER	Staffing for Adequate Fire and Emergency Response

SBA	Small Business Administration
SFHA	Special Flood Hazard Areas
sq mi	square mile
SRL	severe repetitive loss
Stafford Act	Robert T. Stafford Disaster Relief and Emergency Assistance Act
STAPLEE	Social, Technical, Administrative, Political, Legal, Economic and Environmental
SWCD	Soil and Water Conservation District
TF	technical feasibility
Tri-Met	Tri-County Metropolitan District of Oregon
UGB	Urban Growth Boundary
UHMA	Unified Hazard Mitigation Assistance
URS	URS Corporation
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey

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NFIP COMPLIANCE

- Total # of properties exposed to flood risk – 9,739; 29,000 residents (HAZUS MH 04; OEM approved Hazard Analysis December 2006)
- Year community entered NFIP – 1972 through Flood Plain Ordinance No. 134486, which established and authorized its cooperation in the NFIP.
- Year Initial Firm Identified – October 15, 1980; program validated through Portland City Code 24.50 outlining building regulations in flood prone areas
- Ordinance No. 160413 effective Jan 14, 1998, Amended October 2004, August 2006, Nov. 26, 2008, May 2009, established Chapter 24.50 Flood Hazard Areas. The purpose of the Chapter is to protect the public health, safety and welfare by restricting or prohibiting uses which are dangerous to health, safety, or property in times of flood or which cause increased flood heights or velocities and by requiring that uses and structures vulnerable to floods be protected from flood danger at the time of initial construction.
- October 1, 2001 National Flood Insurance Program Community Rating System Class 6
- October 1, 2007 National Flood Insurance Community Rating System Class 5
- Operating under current FIRM, October 19, 2004
- Study underway, January 15, 2010 the Preliminary Flood Insurance Study; City of Portland Oregon Multnomah, Clackamas and Washington Counties; FEMA Flood Insurance Study Number 410183V000B." this Flood Insurance Study (FIS) revises and updates a previous FOS and Flood Insurance Rate Map (FIRM) for the City of Portland, Oregon. This information will be used by the City of Portland to update existing floodplain regulations as part of the Regular Phase of the National Flood Insurance Program (NFIP). The information will also be used by local and regional planners to further promote sound land use and floodplain development."
- Total # of NFIP Policy Holders – for CID 410183 – 2,084
- No. of Paid Losses: 135
- Total Losses Paid: $2,456,761.05
- Sub. Damage Claims since 1978
- Initial FHBM: 1/10/1975

Repetitive Loss Properties

6215 SE 103 Ave.; Portland**,** OR 97266 – single fam, property value - $88,020.
11/19/96 - $37,988.32; 02/08/96 - $3,437.96; 11/11/95 - $4,808.16
Total - $46,234.44

10215 SE Foster Rd.; Portland, OR 97266 – non res, property value - $50,000.
11/18/96 - $4,360.24; 02/08/96 - $1,642.57; 11/11/95 - $11,599.12;
02/20/82 – 1,216.
Total $53,601.89 (building $18,817.93 Total contents $34,783.96)

0763 SW Miles St.; Portland, OR 97219 – single fam, property value - $114,206.
12/29/96 - $1,160.00; 02/09/96 - $90,341.06
Total - $91,501.06

11315 SE Harold St.; Portland, OR 97266 – single res, property value - $229,947.
01/02/96 - $11,407.36; 11/19/96 - $1,212.33; 02/08/96 - $4,703.85;
Total - $17,323.54

15300 SE Martins St**.;** Portland, OR 97236 – single fam, property value - $195.979.
01/01/09 - $43,802.11 + $33,026.82; 11/19/96 - $12,195.29 + $3,543.31;
02/07/96 - $1,275. + $467.; 11/27/95 - $1,167.50 + $500.; 11/13/95 - $29,881.97;
Total – $ 125,858.87 (building $88,321.87; contents $37,537.)

15440 SE Martins; Portland, OR 97236 – single fam, property value - $73,300.
11/19/96 - $13,224.52; 02/07/96 - $2,464.21; 11/11/95 - $6,175.33;
Total - $21,864.06

205 SE Spokane St.; Portland, OR 97202 – non res, property value - $433,800.
01/02/97 - $29,084.60; 02/09/96 - $158,303.49;
Total – $187,388.09

12115 SE Brookside Dr.; Portland, OR 97266 single fam, property value - $96,500.
11/19/96 - $17,151.15 + $1,712.13; 11/11/95 - $2,509.83;
Total - $21,972.51(building $20,260.38; contents $1,712.13)

8308A - 8312A SE 21st; Portland, OR 97202 – 2-4 family, property value - $454,195.
01/02/09 - $76,803.; 12/03/07 - $40,132.76
Total - $116,935.80

10207 SE Foster Rd.; Portland, OR 97266 – non res; property value - $187,799**.**
01/01/09 - $15,499.86 + $4,293.83; 12/04/07 – $30,253.92 + $29,121,14;
Total – $79,168.75 (building $45,753.78; contents - $33,414.97)

6215 SE 159th Dr.; Portland, OR 97236 – single fam, property value - $250,750.
11/19/96 - $83,959.92; 11/11/95 - $15,850.74; 02/24/94 - $36,512.01;
02/20/82 - $19,904.07; 01/11/80 - $24,055.07
Total - $180,301.99

Mitigation Actions to address properties

The mitigation strategy identifies actions related to continued compliance with the NFIP. Initial prioritization has taken place in regards to the action's ability to benefit multiple hazards and meet the committee established goals of the 2010 Natural Hazard Mitigation Plan. The next step will be to elicit citizen input for a Citizen Mitigation Action Plan that will survey citizens about their priorities and the attainability of the priorities.

Actions of the NHMP that address NFIP are:

STMH #5 (Short Term Multi-Hazard) Acquire light detection and Ranging (LiDAR) images of the Portland Metro area to facilitate natural hazard area risk assessment and vulnerability analysis to provide detailed topographic maps that will validate NFIP FIRMs. The most recent update of City Code adopted Flood Insurance Study (2004) as the official scientific engineering report, the flood Insurance Rate Map as the official map, the Water Features Map of 1981 and the February 1996 Flood Inundation Map as adopted in 1998 by Metro, could be reviewed against latest technology for accuracy and possible implications.

#4 - STMH #11 Implement actions in the 2005 Portland Watershed Management Plan ensuring damage abatement and attention is assigned to reduce losses and damage to structures and City residents. A multi-hazard benefit, this action will impact landslides, erosion, the impact of severe weather and the reduction of the impact of flooding.

#11 -LTMH #1 (Long Term Multi-Hazard) Revise Portland's Comprehensive Plan to address and implement City wide policies, land use improvements and mapping changes of natural hazards including, but not limited to earthquakes, erosion, floods, invasive plants, landslides, volcano, severe weather and wildfires.

#16 - LTMH #8 Review and amend City Code and other compliance documentation to require that all facilities that store or handle hazardous materials and which are located in the 500- year floodplain, landslide, or other hazard areas, develop a hazardous materials inventory statement. This statement will be made available for Fire Bureau review. Require that these storage tanks are either adequately protected or relocated outside of the 500-year floodplain, landslide, or other hazard areas.

#21 - NEW MH Identify and list repetitively flooded structures and infrastructure, analyze the threat to these facilities and prioritize mitigation actions to protect the threatened population.

#22 - NEW MH Acquire (buy-out), demolish, or relocate structures from hazard prone area. Property deeds shall be restricted for open space uses in perpetuity to keep people from rebuilding in hazard areas.

#24 - NEW MH Develop and incorporate building ordinances commensurate with building codes to reflect survivability from all hazards to ensure occupant safety.

#57 - FL #1 (Flood) A covenant recorded with the deed of new development in the floodplain to ensure that space below the base flood elevation is not converted to habitable space. This should be codified to improve compliance.

#65 - LT FL #1 Increase funding for the Johnson Creek Willing Seller Program; establish willing seller programs in other watersheds where flood hazard and priority restoration areas coexist.

#66 - LT FL #3 Develop a plan for addressing flooding in the Holgate Lake area.

#67 - LTFL #4 Improve hydraulic bottleneck that prevents discharge of chlorinated effluent to the Willamette River during high river levels.
#69 - LTFL #6 Partner with Army Corp of Engineers to conduct modeling of the Willamette River upstream of Portland to identify areas that, if acquired or restored, would contribute to mitigate peak flows in Portland or result in significant reduction of flood damages.

#71 - LTFL #8 Develop goals, policies and implementation measures to manage the amount of new impervious surface and remove existing impervious surfaces where appropriate. These goals, policies and measures may be at the citywide, watershed, or sub-watershed level.

#74 - LTFL #11 Provide funding for and participate in development of a flood inundation model for the managed floodplains and downtown sea wall.

#79 - LT FL #14 Complete update to the Johnson Creek Restoration Plan. Develop individual plans for each sub-watershed to address the sources of excess stormwater runoff that exacerbates flooding.

Section A – Assets

A.1 Comprehensive Plan Map (May 2010)
A.2 Natural Resources Overlay Zone (May 2010)
A.3 Emergency Transportation Routes
A.4 Hazard Transportation Route Maps
- A.4.1 Hazard Transportation Route 1
- A.4.2 Hazard Transportation Route 2
- A.4.3 Hazard Transportation Route 3
- A.4.4 Hazard Transportation Route 4

A.5 City Owned Properties
A.6 Parks Map

Section B – Hazards

B.1 Earthquake Subzone Map
- B.1.1 West Hills Fault Line Map

B.2 Snow Areas Map
B.3 FEMA 100-year Flood Map
B.4 Wildfire, Landslides and Earthquake Fault Line Hazards Map

Section C – Vulnerable Sites

C.1 Unreinforced Masonry Buildings (URM) Map
C.2 Repetitive Loss Properties Map
C.3 Water Deficiency Area Map

Figure J-A1 Comprehensive Plan Map (May 2010)

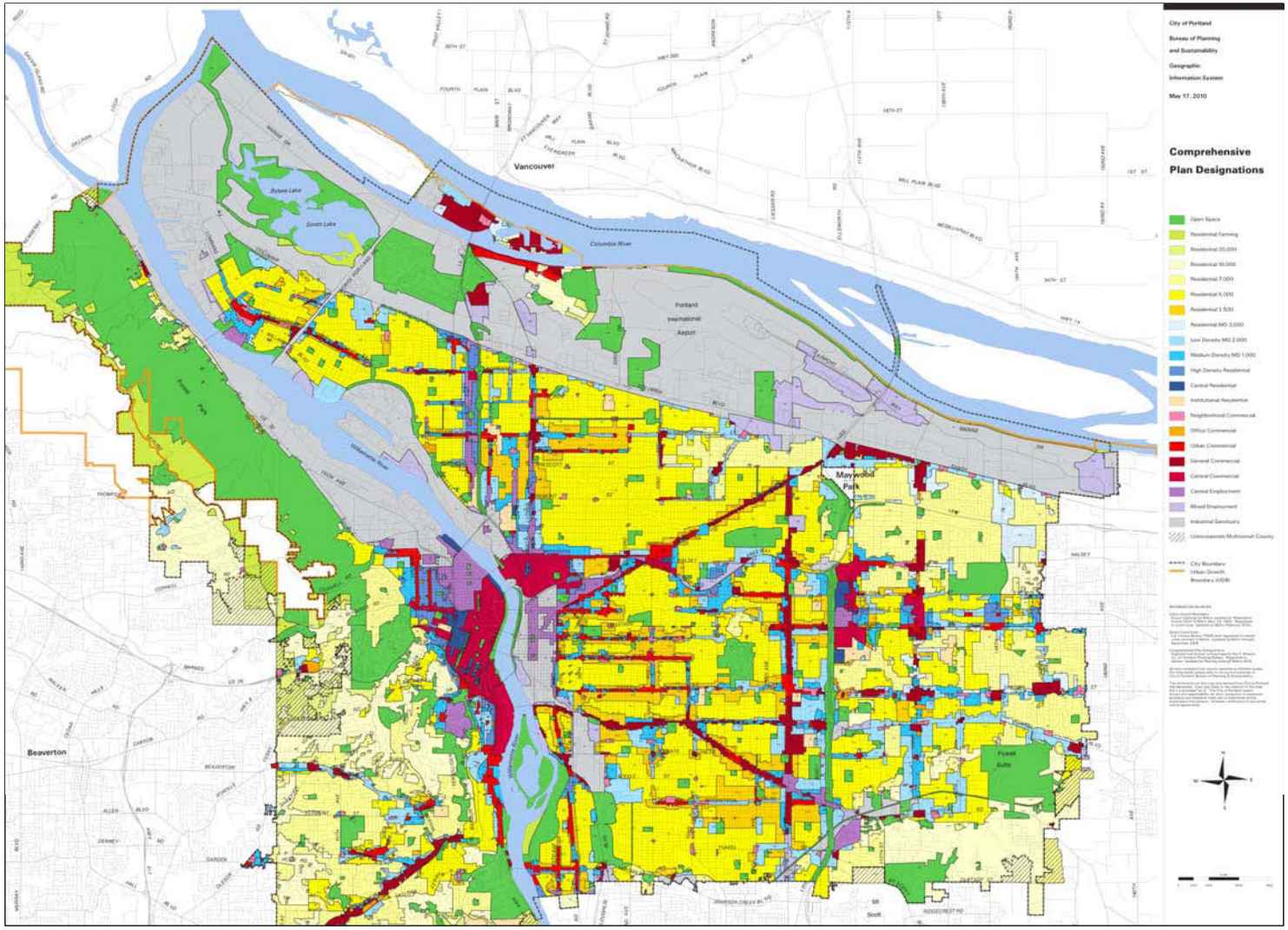

Figure J-A2 Natural Resources Overlay Zone (May 2010)

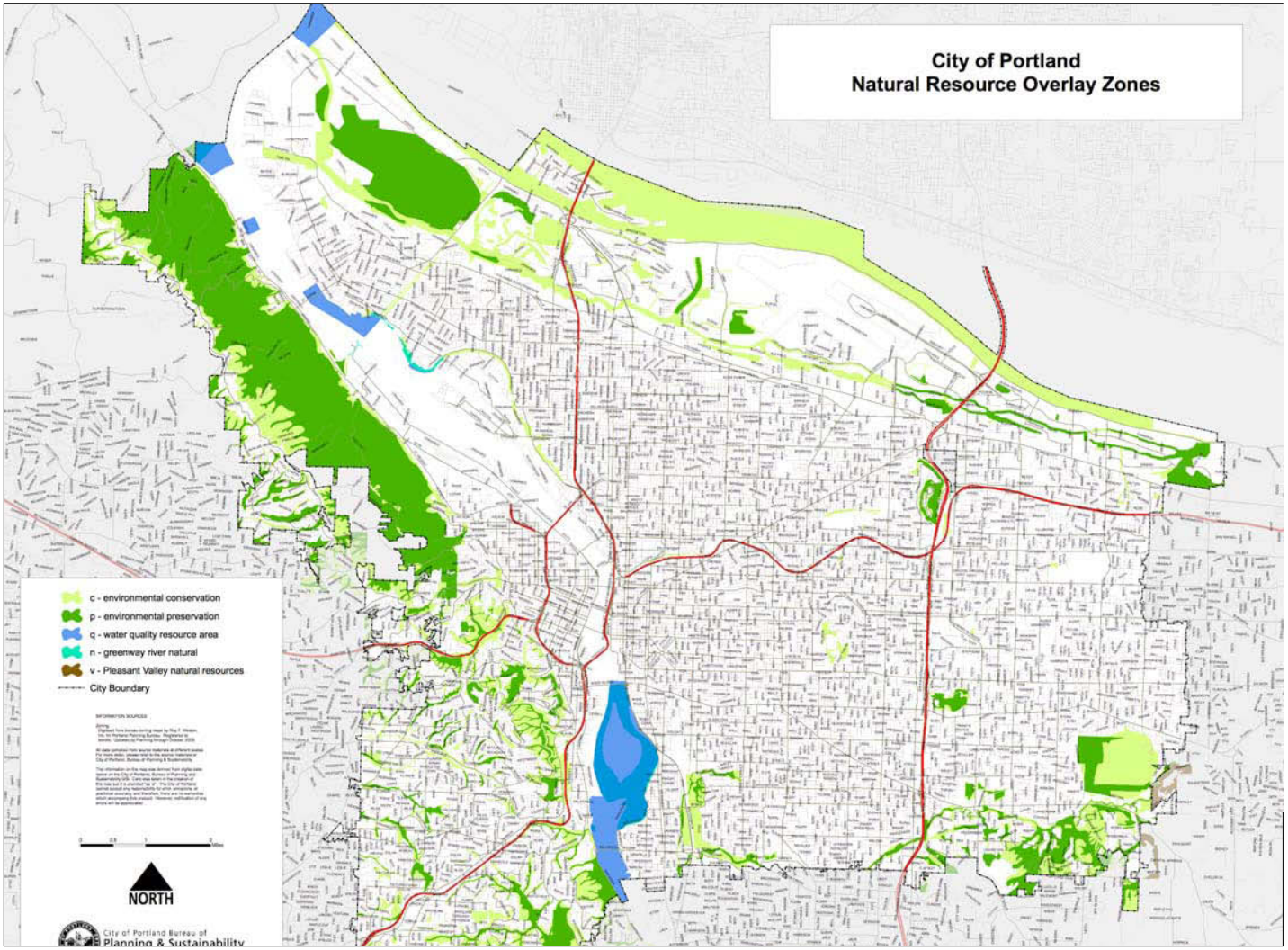

Figure J-A3 Emergency Transportation Route Full Map

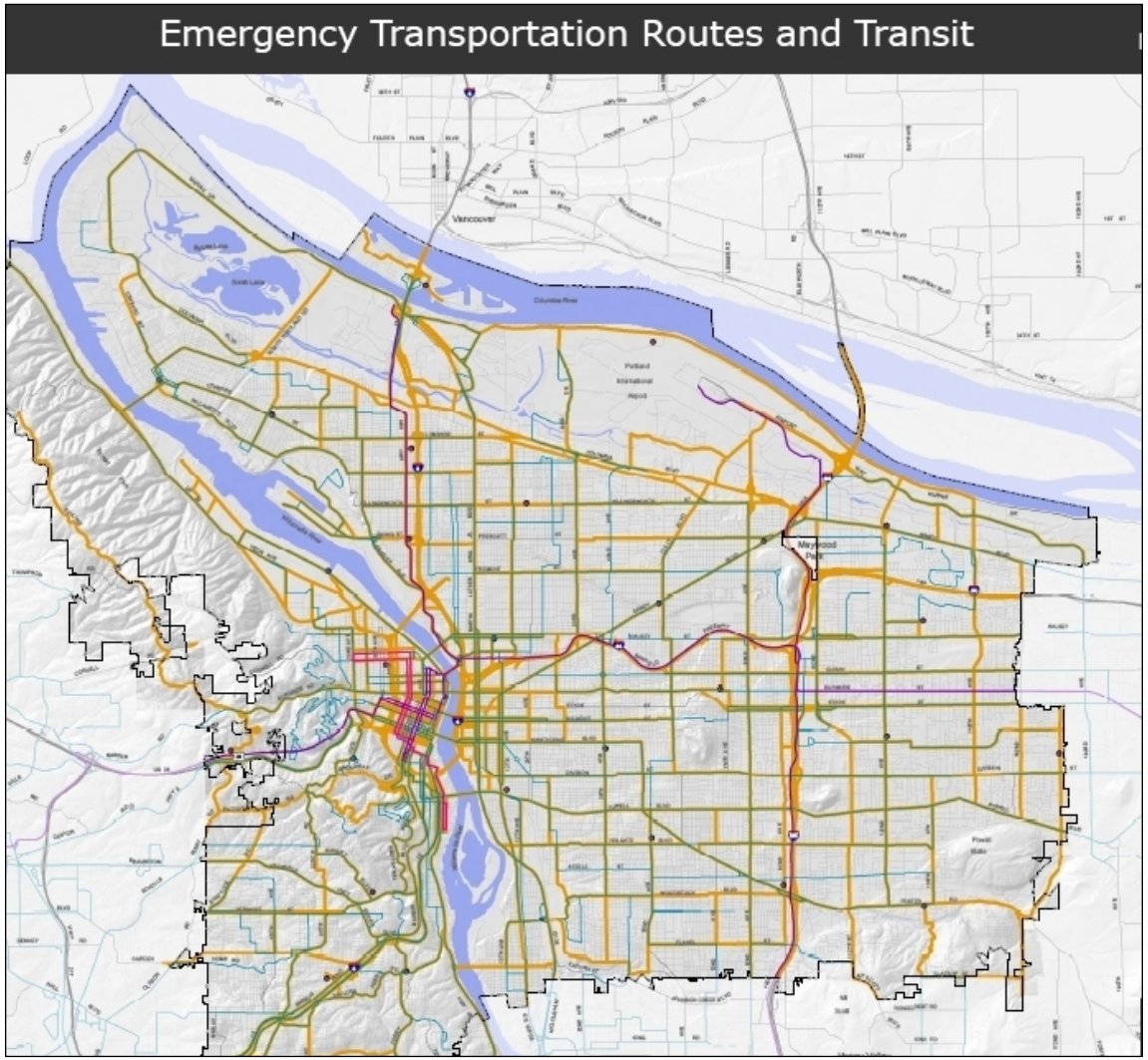

Figure J-A4.1 Hazard Transportation Route Map 1

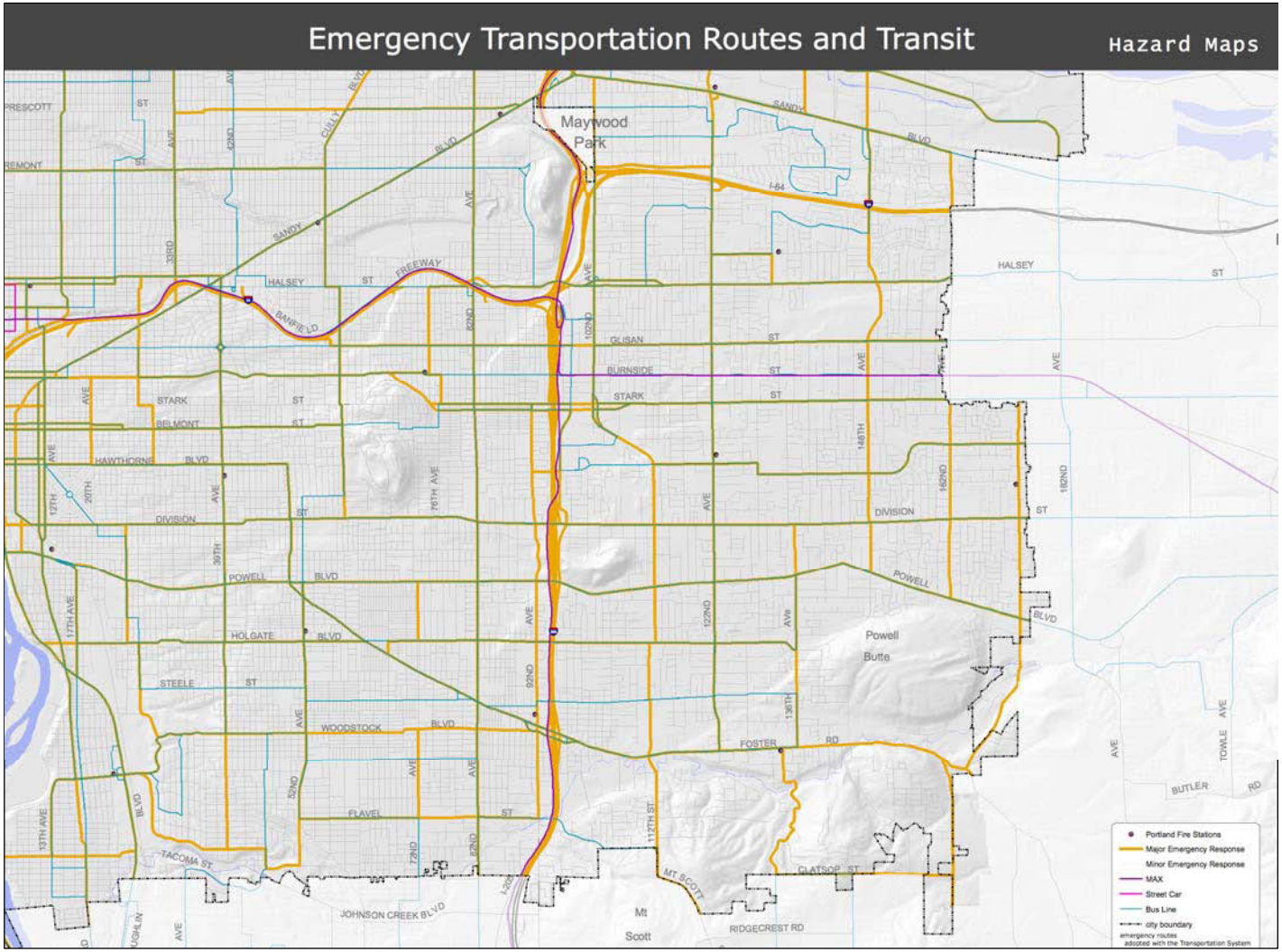

Figure J-A4.2 Hazard Transportation Route Map 2

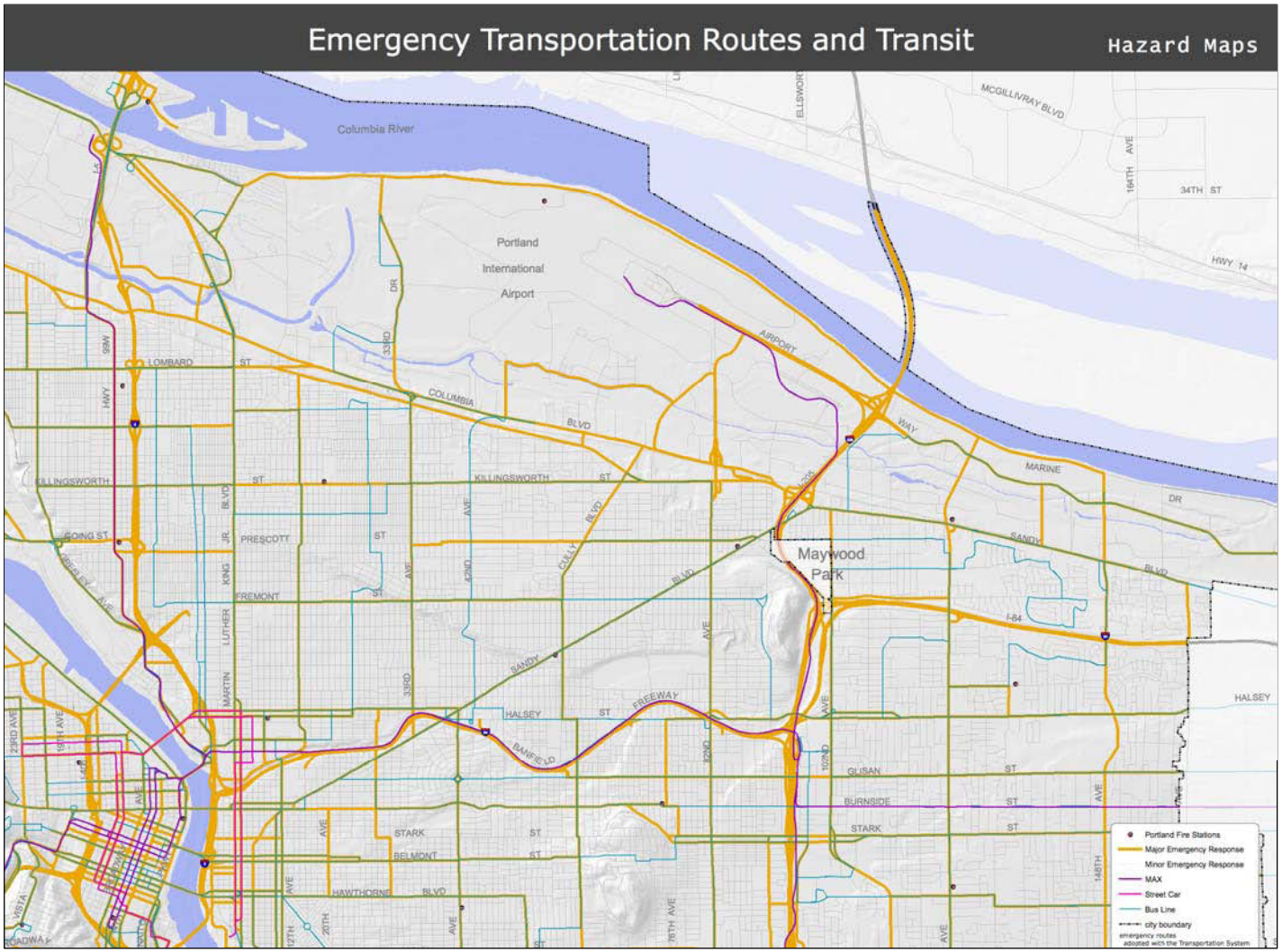

Figure J-A4.3 Hazard Transportation Route Map 3

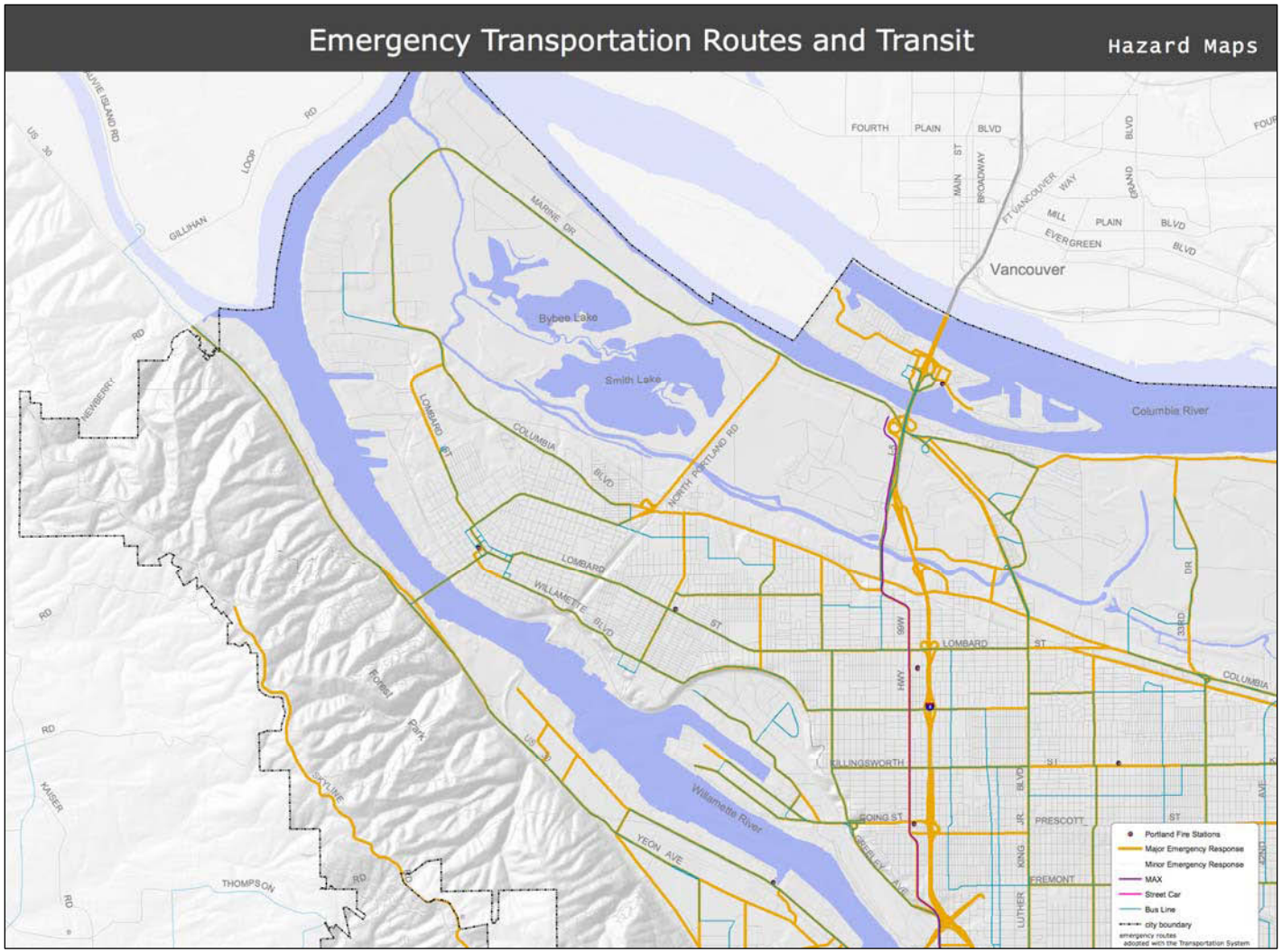

Figure J-A4.4 Hazard Transportation Route Map 4

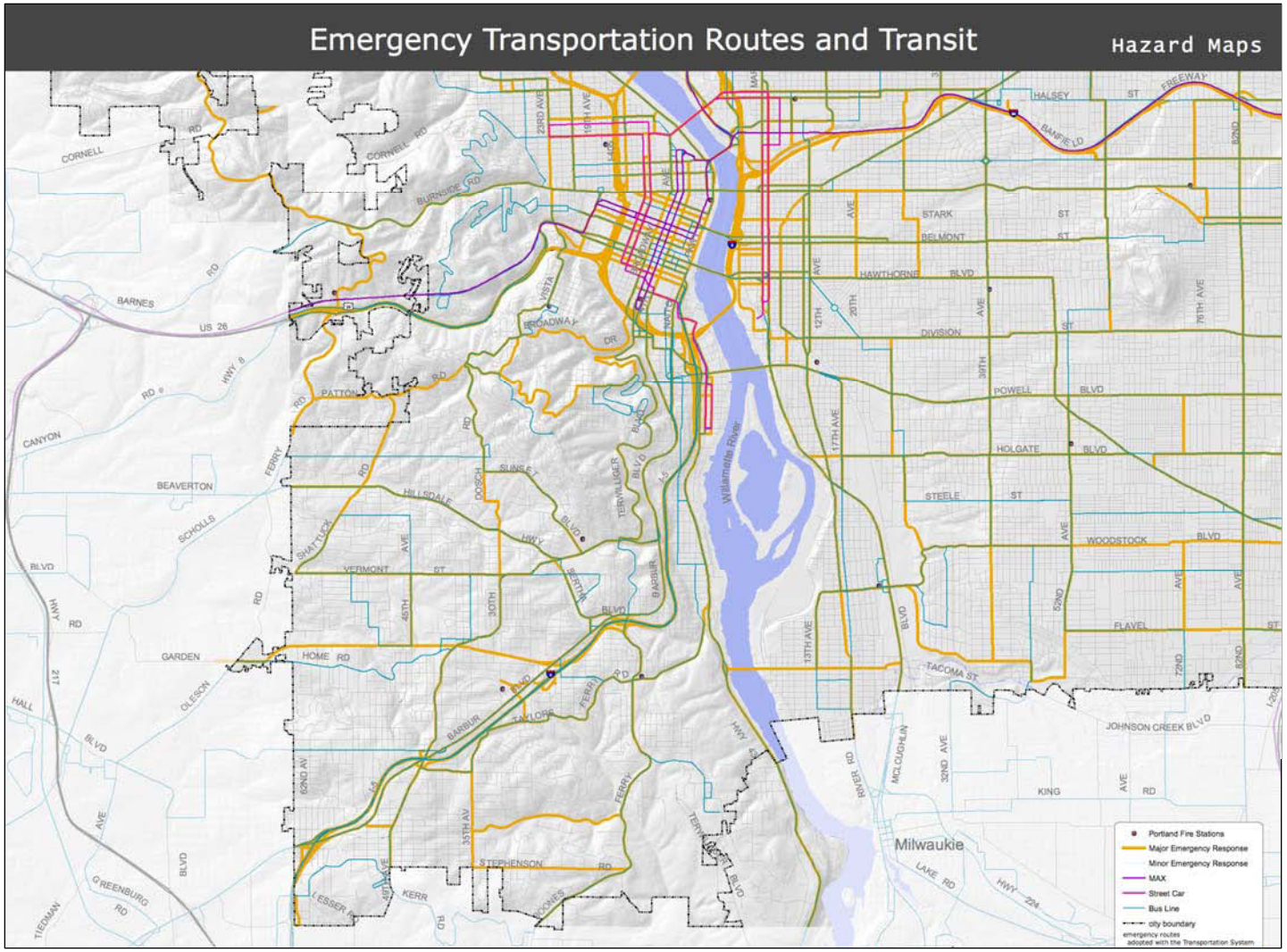

Figure J-A5 City-owned Properties Map

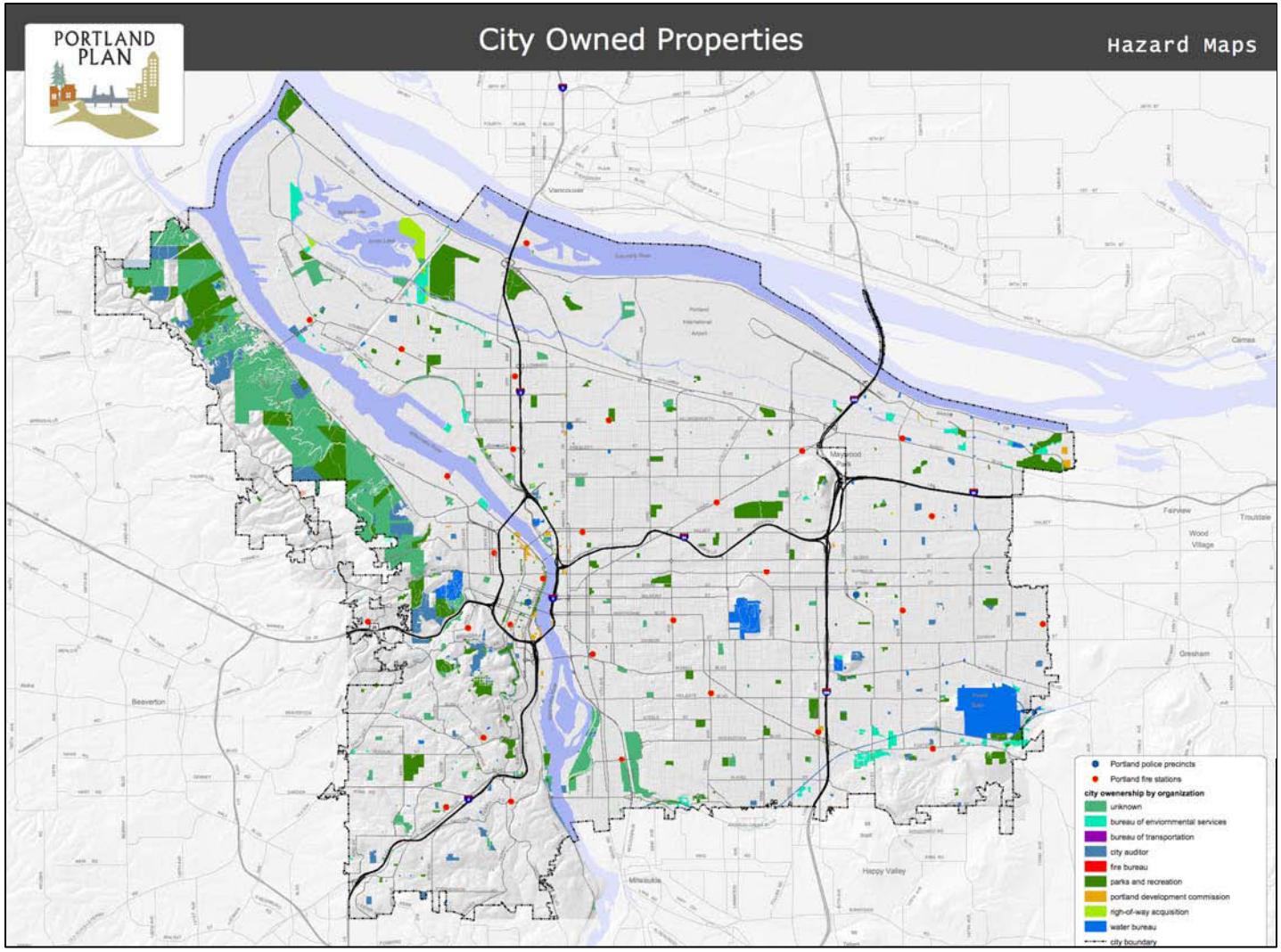

Figure J-A6 Parks Map

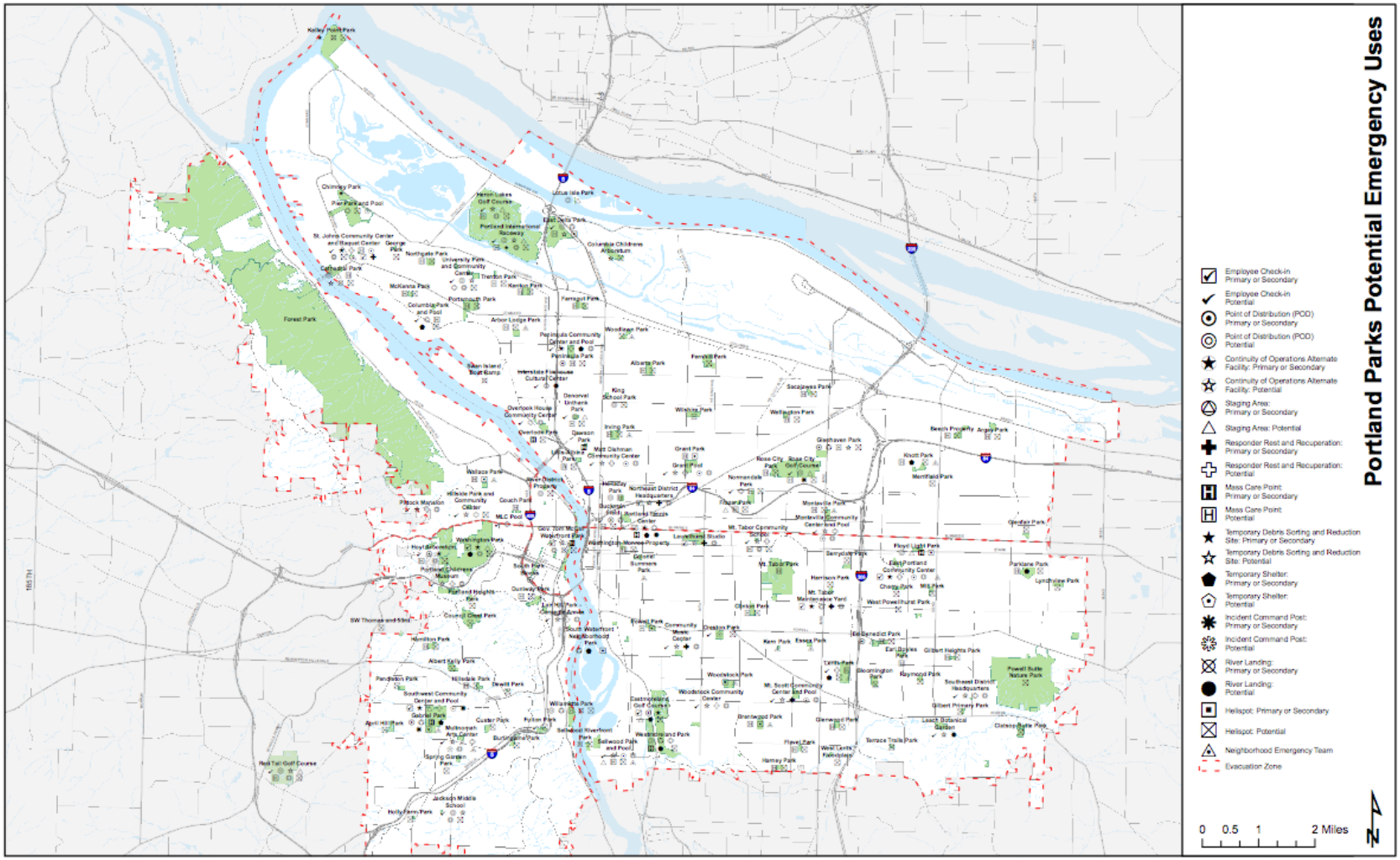

Figure J-B1a Earthquake Subzone Map

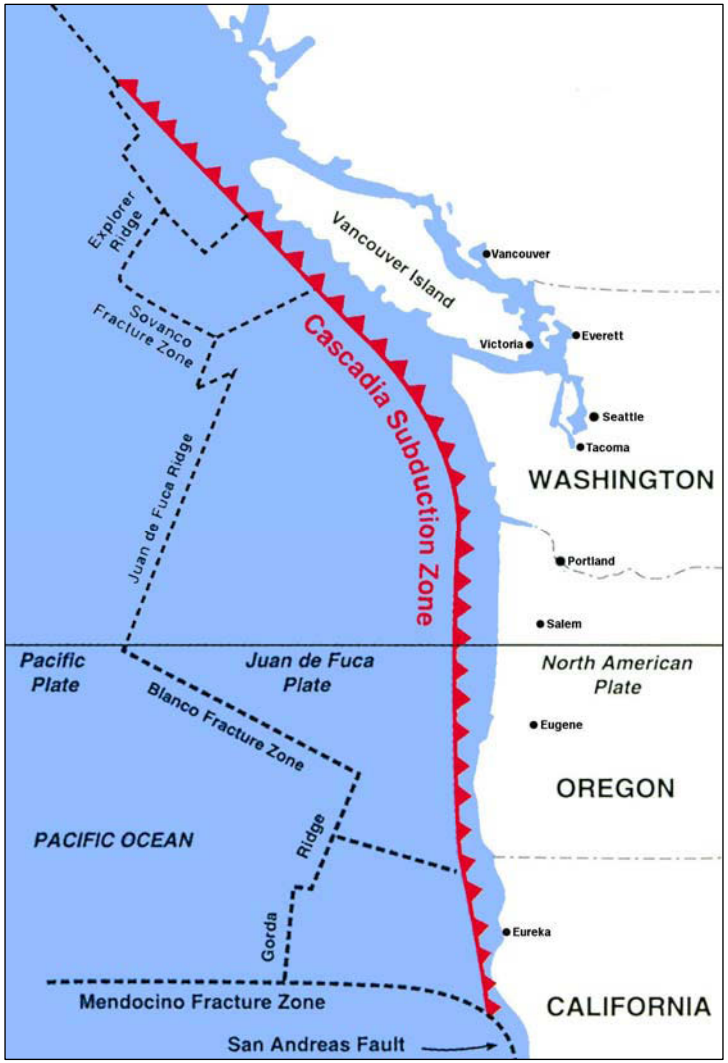

Figure J-B1b West Hills Fault Map

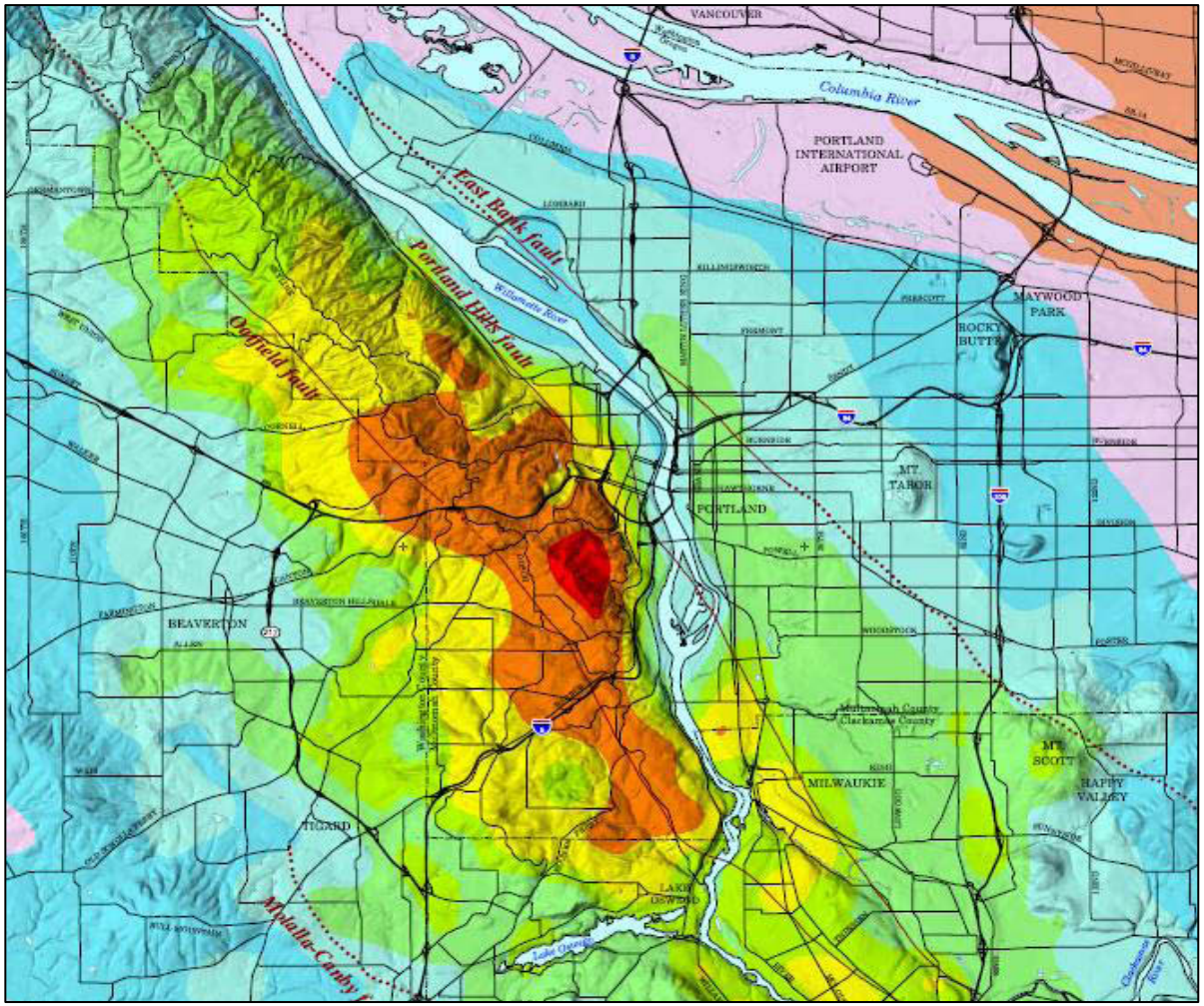

Figure J-B2 Snow Areas Map

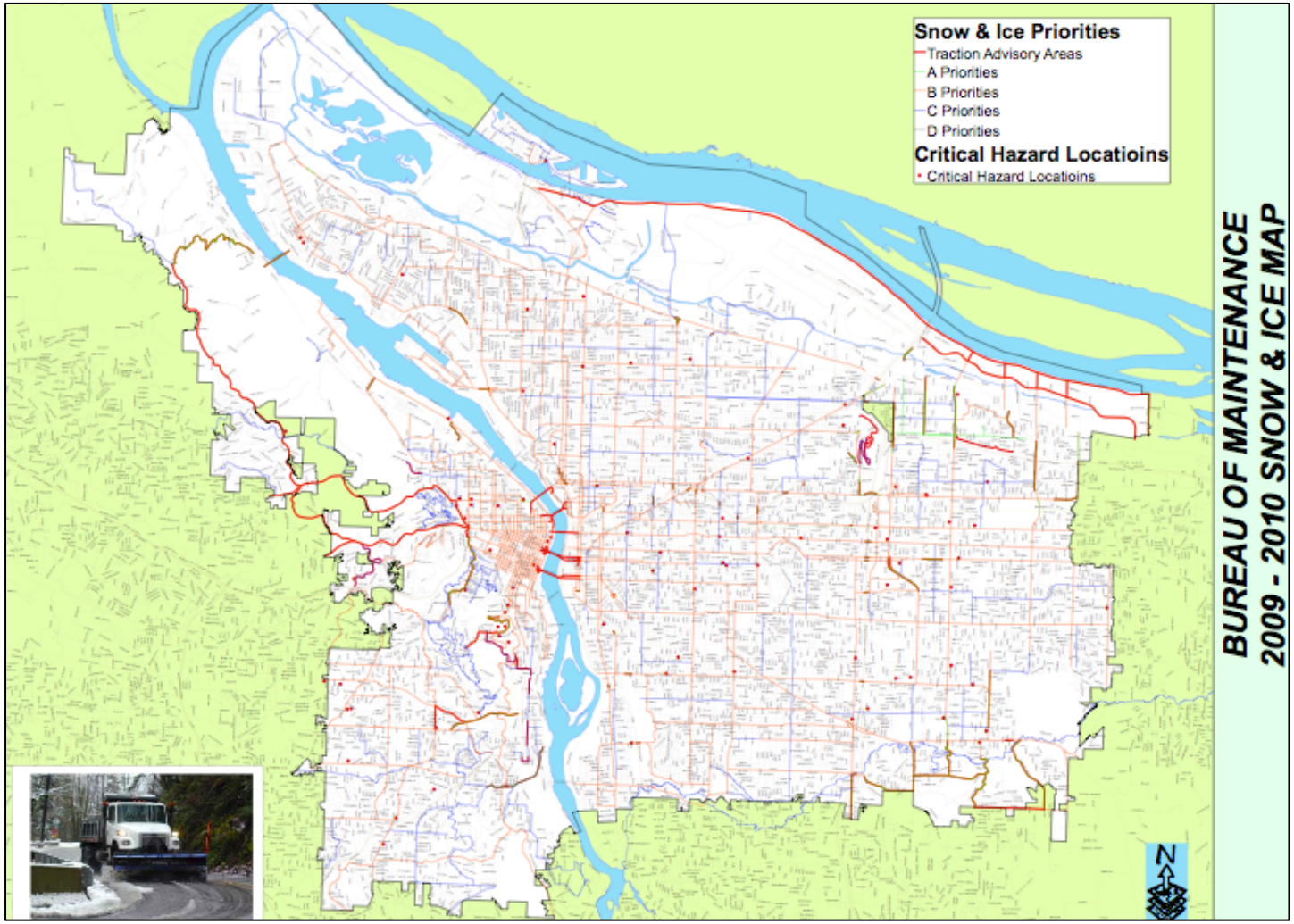

Figure J-B3 FEMA 100-year Flood Map

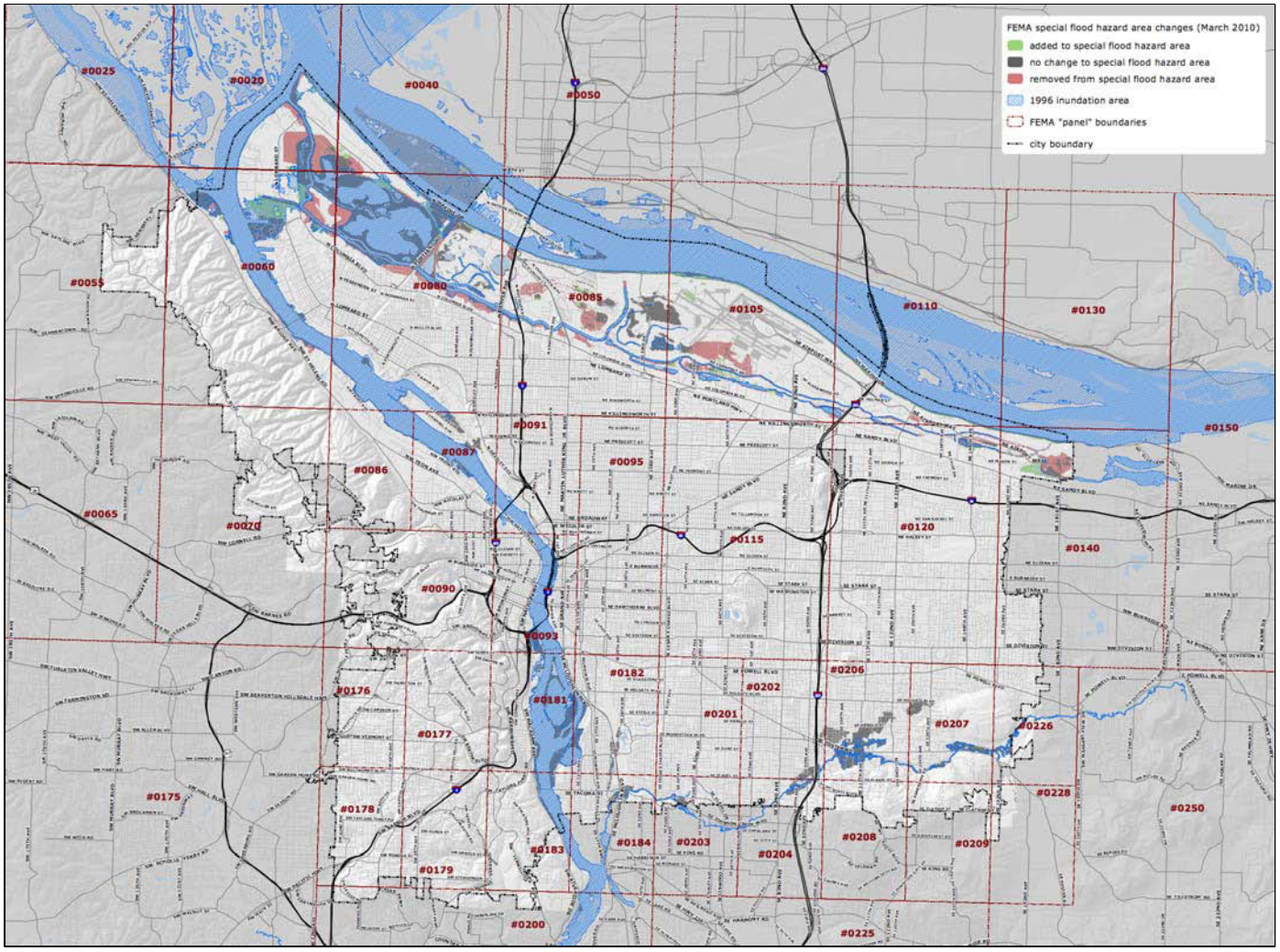

Figure J-B4 Wildfire, Landslides and Earthquake Fault Line Hazards Map

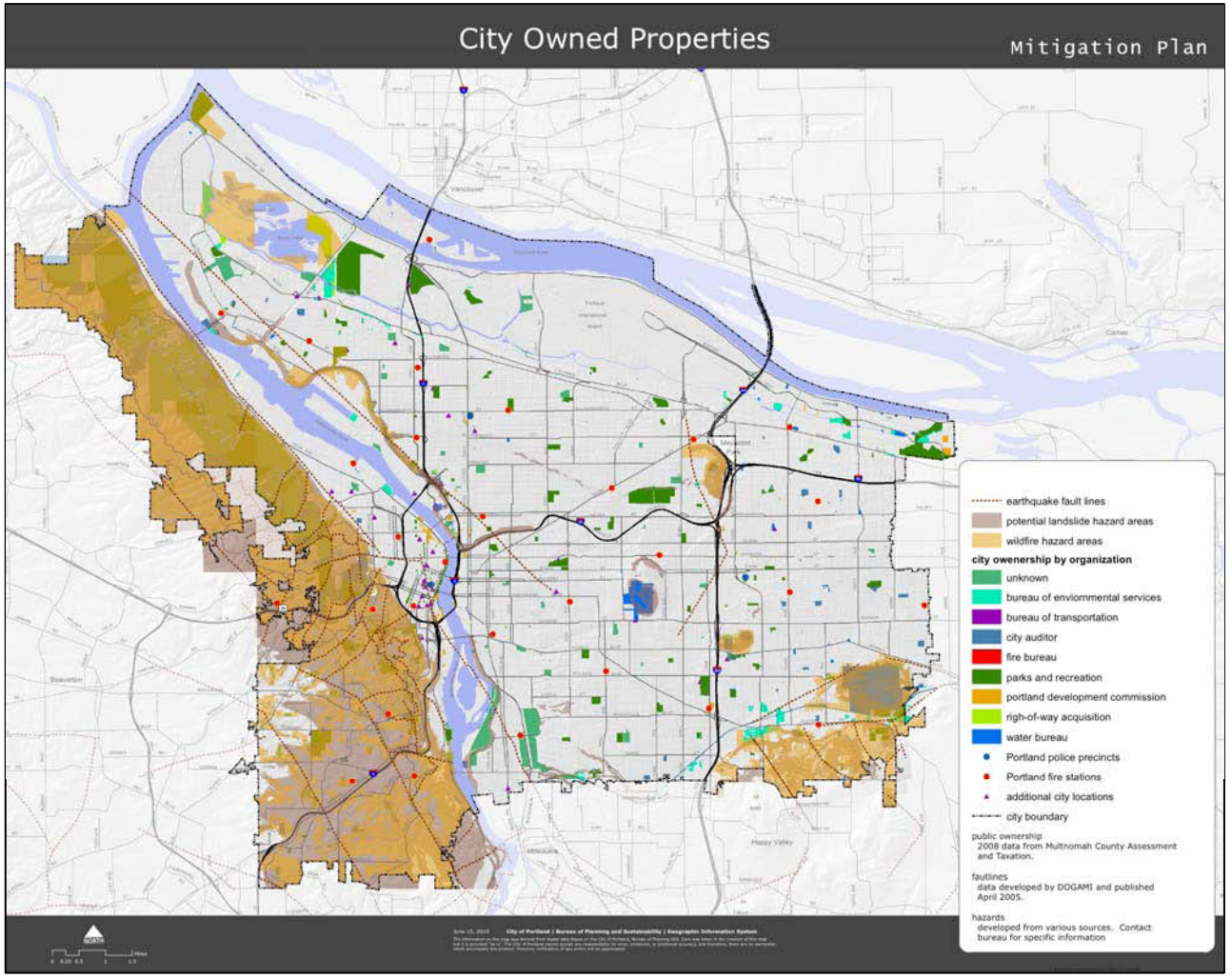

Figure J-C1 Unreinforced Masonry Buildings (URM) Map

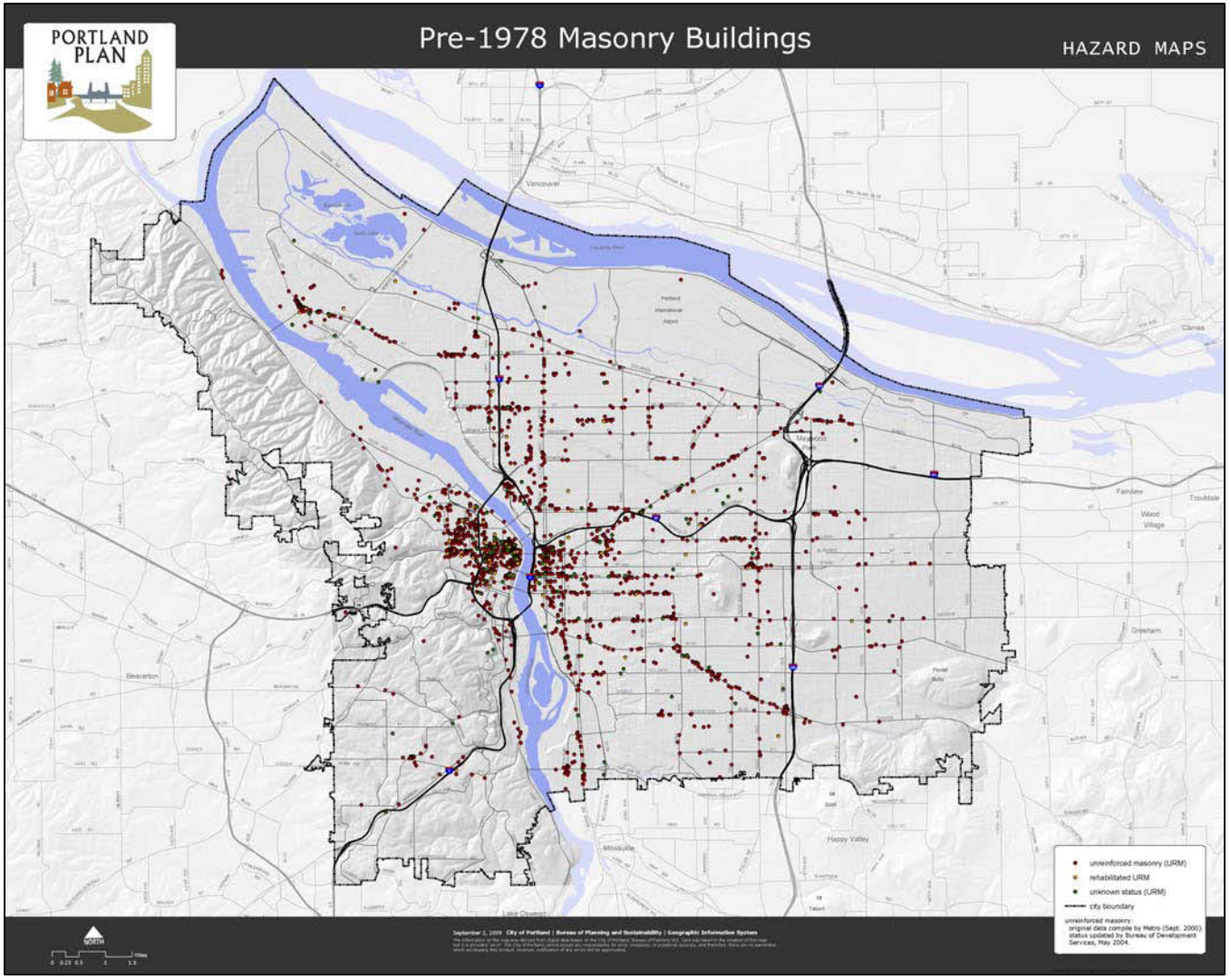

Figure J-C2 Repetitive Loss Properties Map

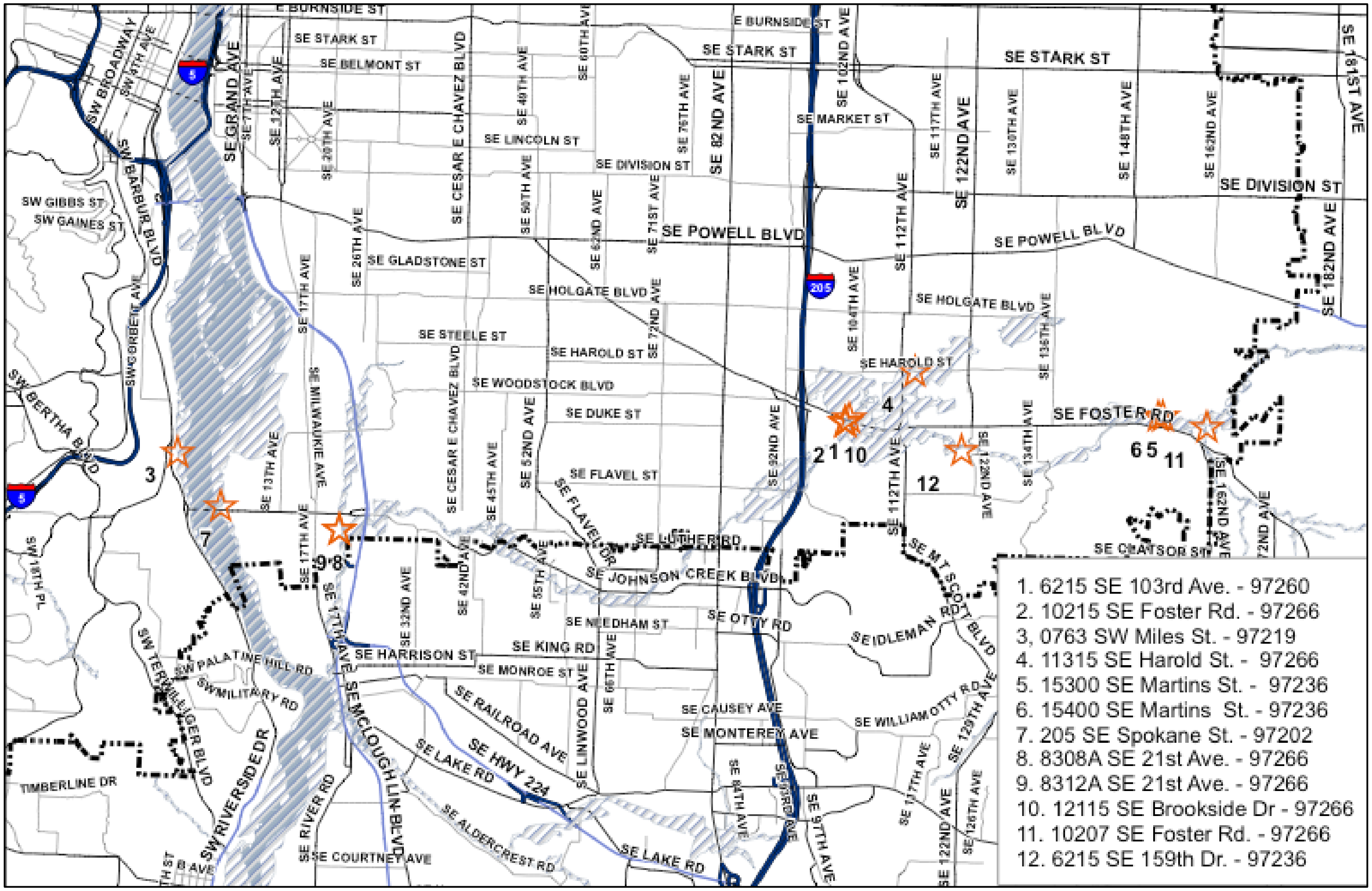

Figure J-C3 Water Deficiency Area Map