Centre d'Etude des Risques Géologiques
Sciences de la Terre, CERG - UNIGE
13, Rue des Maraîchers, 1205 GENEVA - Switzerland
Tel.: +41 22 379 66 02 Fax: +41 22 379 32 10
Email: cerg@unige.ch, Web: http://www.unige.ch/hazards

CERG 2005

"The City of Portland's Natural Hazard Mitigation Plan: Idealistic or Realistic? "

by

Tricia SEARS

In association with:

Iate/lms

The City of Portland's Natural Hazard Mitigation Plan: Idealistic or Realistic?

Tricia R. Sears
Portland, Oregon, USA
Centre d'Etude des Risques Geologiques (CERG)
University of Geneva
May 28, 2006

Abstract

Apply the risk management framework studied during the post graduate program, "The Study and Management of Geological Risks" at the Centre d'Etude des Risques Geologiques (CERG) at the University of Geneva to the City of Portland, Oregon's risk management framework. The CERG risk management framework includes the essential four components: to identify the hazard (including the hazard phenomena), to identify the vulnerability, to perform a risk assessment and identify the management of the hazard, and to identify how to prevent and to prepare for disasters (risk management).

Within the CERG risk management framework, identification of hazards is part of the framework. The use of the term risk management instead of hazard management is important. Risk management is more encompassing of the multiple aspects of hazards, vulnerability, and risks. The social, political, economic, and environmental aspects of a society are included.

The term hazard management is sometimes used instead of risk management in the United States. The City of Portland's Natural Hazard Management Plan is a tool in the City's risk management program. This paper analyzes the City of Portland's recently approved Natural Hazard Mitigation Plan (NHMP) in relationship to the CERG risk management framework. Does the NHMP fit within the CERG risk management framework? Is the plan idealistic or realistic? Will the City be adequately prepared with the NHMP or should additional steps be taken? To answer these questions, the risk management framework at the City of Portland, State of Oregon, and Federal level is examined, and is discussed in relationship to the CERG risk management framework.

Table of Contents

List of Figures

THE CITY OF PORTLAND'S NATURAL HAZARD MITIGATION PLAN: IDEALISTIC OR REALISTIC?

Introduction

People know disasters happen. Each day, a person can read the newspaper or listen to the radio and learn of a new disaster or get more details on a recent disaster. Disasters are huge and scary events that seem overwhelming, and often people think they cannot happen where they live. But the reality is that disasters do happen where we live.

"No single term has yet emerged that defines the areas where disasters are more commonplace; but whatever the denomination, there is always an implicit understanding the place in question is somewhere else, somewhere else where "they" as opposed to "we" live, and denotes a land and climate that have been endowed with dangerous and life-threatening qualities" (*Mapping*, 29).

With the perspective and perception that disasters happen elsewhere, in lands faraway from the everyday life a person is familiar with, a discussion of risk management seems frivolous and unnecessary. But in reality, a disaster can happen anywhere, at any time. To know and to understand the importance of identifying the hazard to a community is to acknowledge that a disaster can occur. With the acknowledgement that a disaster can occur, a determination of acceptable risk occurs; there is a decision either implicitly or actively made by the community about acceptable risk.

"The perception of risk and vulnerability, and even impact, is clearly mediated through linguistic and cultural grids, accounting for great variability in assessments and understandings of disasters. There is no question that the variability of interpreting the threat or the impact of disaster is extremely wide and is largely a function of social and cultural characteristics of individuals, primarily related to degrees of integration and group power relations" (*Mapping*, 17-18).

"Critical to discerning the nature of disasters, then, is an appreciation of the ways in which human systems place people at risk in relation to each other and to their environment – a relationship that can best be understood in terms of an individual's, a household's, a community's, or a society's vulnerability" (*Mapping*, 2).

Later in this paper I will define and discuss vulnerability, and the relationship of vulnerability with disaster resilience. These terms relate to the capacity of a community to withstand and recover from a disaster.

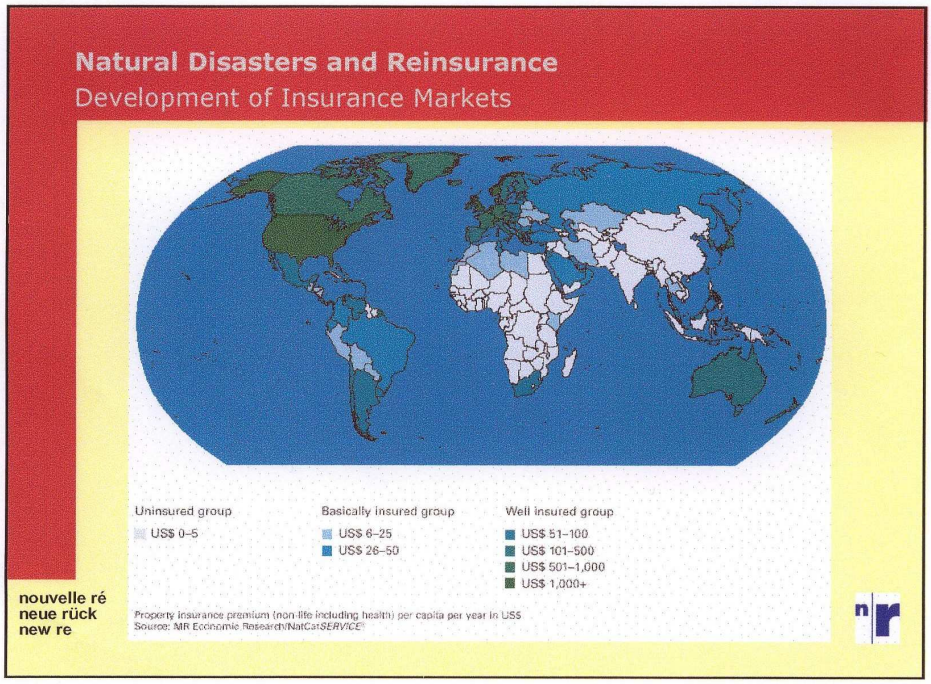
"Proponents of vulnerability as a conceptual explanation take the position that while hazards may be natural, disasters are generally not" (*Mapping*, 29).

Indeed, hazards occur regardless of human existence. The earth changes over time. Human existence inherently changes the earth; humans use resources of the earth to survive. Around the world, societies develop different ways to exist. The social, political, economic, and environmental conditions of a society vary widely around the world. Both developing and developed countries have these conditions that contribute to how and when a disaster occurs.

"In developing countries, social, economic, cultural, educational aspects are, in most cases, the cause of the potential physical damage (physical vulnerability). In contrast to the hazard, global vulnerability is a condition that is constructed, accumulates and remains over time and is closely linked to social aspects and to the level of development of the communities" (*Mapping*, 39).

The differences in the developed versus developing countries, in terms of loss of life and economic impact when a disaster occurs, is staggering. The insurance system calculates that the majority of fatalities from natural disasters are in uninsured countries; that a disproportionate majority of the economic losses occurs in insured, industrial countries; and that more than 95% of insured losses are paid out to countries with good insurance coverage (Sonnleitner, 2005). More people in industrialized countries take out insurance than people in non-industrialized or developing countries. The graphic below shows the countries of the world with categories in the "uninsured group", "basically insured group", and "well-insured group". The values shown are given in U.S. dollars.

Figure 1



The economic impact comparison is evaluated in terms of insurance rather than other methods. Uninsured persons suffer great economic impact as a result of a disaster. The enormous devastation brought by the disaster could have destroyed life as that person knows it. Now the person has nowhere to live nor do they have a means to make a living. In addition to the environmental impacts, the impacts of the devastation are physical, economic, social, and mental. How does a person prepare and recover? How does a community prepare and recover?

"Disasters as multi-dimensional, all-encompassing occurrences sweep every aspect of human life, impacting environmental, social, economic, political and biological conditions. Vulnerability can become a key concept in translating that multi-dimensionality into the concrete circumstances of life that account for disaster" (*Mapping*, 10).

"Disasters exist as complex material events and, at the same time, as a multiplicity of interwoven, often conflicting, social constructions. Both materially and socially constructed effects of disasters are channeled and distributed in the form of risk within society according to political, social, and economic practices and institutions. This is the essence of vulnerability" (*Mapping*, 10-11). "Disasters seem to be especially apt as contexts and processes that illuminate these complex relationships, particularly in the way that they challenge societies materially, socially, and ideologically" (*Mapping*, 11).

The definition of disaster is "a sudden calamitous event bringing great damage, loss, or destruction" and "an event or situation that is regarded as a terrible misfortune" (*Webster*, 321). Another definition of disaster is "A serious disruption of the functioning of a society, causing widespread human, material, or environmental losses which exceed the ability of affected society to cope using only its own resources. Disasters are often classified according to their speed of onset (sudden or slow), or according to their cause (natural or manmade)" (CERG 2005). This second definition includes a more obvious connection to a community's ability to withstand an event or disruption.

Perhaps people are not entirely aware of how they can make a difference in how disasters happen, and how they can mitigate the impacts of disasters. The City of Portland, the State of Oregon, and the Federal government of the U.S. have established a labyrinth of regulations related to risk management. The risk management framework that these regulations provide may or may not be effective. The general public, government staff, and politicians may or may not understand their role or relationship to risk management. The global risk management framework, herein referred to as the CERG risk management framework, is applied to the City of Portland Natural Hazard Management Plan to illustrate the complexities of a risk management framework. The City of Portland's NHMP is one aspect of the City's risk management framework, a framework which is intricately interwoven with the State of Oregon and U.S. Federal government risk management framework. An important aspect of the risk management framework is the subject of acceptable risk, and the social, political, economic, and environmental conditions that a community has. Perception plays a critical role in the community's decision-making process about acceptable risk. Later in this paper, there will more

discussion of perception and acceptable risk, and the link to vulnerability and disaster resilience.

CERG Risk Management Framework

Introduction

For risk management, a community must identify the hazards, the vulnerability, and the risk. The CERG program at the University of Geneva focused on a risk management framework that utilizes four components: 1) identify the hazards and the hazard phenomena; 2) identify the vulnerability; 3) identify the risk; and 4) risk management. Risk management is also referred to as prevention and preparedness.

The CERG program uses the definitions of hazard, vulnerability, and risk as written in the *Internationally Agreed Glossary of Basic Terms Related to Disaster Management* (CERG, 2005). Hazard is defined as "A threatening event, or the phenomenon with a given time period and area." Vulnerability is defined as "Degree of loss (from 0 to 100%) resulting from a potentially damaging phenomena." This is a very mathematical definition. However, the definition relates to capacity – how much exists and how much is lost as a result of damage? The definition of vulnerable provides a more personal sense about what vulnerability is; as defined, vulnerable is "open to attack or damage" (*Webster's*, 1304). The definition of risk is "Expected loss (of lives, persons injured, property damage, and economic activity disrupted) due to a particular hazard for a given area and reference period. Based on mathematical calculations, risk is the product of hazard and vulnerability." The CERG program also uses the definition of risk where the risk is equal to the hazard multiplied by vulnerability and value. This definition of risk was provided by one of our professors during the CERG 2005 program. Through both classroom and field study, we applied the CERG risk management framework to volcanic risks, seismic risks, risks related to unstable terrain, and hydro-meteorological risks.

Identify the Hazard

The first component of the CERG risk management framework is to identify the hazard. To identify the hazards, the first step is the hazard assessment. We used geological maps, articles, and field observations to identify phenomena for a hazard. For example, if the hazard is a volcano, observations of the phenomena of rockfall, landslide, gas emission, lava flow and so forth may be made. These phenomena are mapped. In some cases, the phenomena may create secondary phenomena. For example, during the fieldwork on the Island of Volcano, we mapped the hazard of a landslide and we mapped a landslide creating a tsunami. Sometimes mapping of the hazard must include consideration of how the wind flows, as in the phenomena of gas and ashfall. Each phenomenon was mapped to show the location and the intensity of the phenomenon in a given location. These mapped phenomena are the hazard maps. The hazard maps use the hazard matrix; the hazard matrix is an intensity of the hazard scale with a probability scale. The hazard matrix we used for all of our hazard maps in the CERG risk management framework had red for high hazard, orange or blue for medium hazard, and yellow for low hazard.

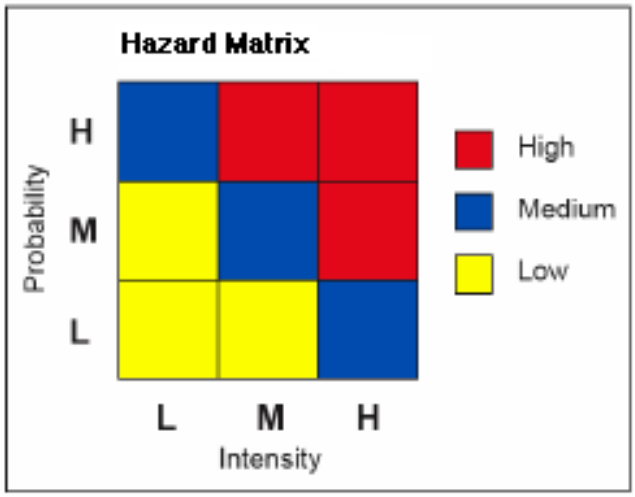


Figure 2

Hazard levels. The red color represents a high level of hazard, blue a medium level, yellow a low risk and white no hazard.

Identify the Vulnerability

The second component of the CERG risk management framework is identification of vulnerability. The vulnerability assessment includes an identification of the critical facilities of the community. Later in this paper, critical facilities, as defined by the U.S. Disaster Mitigation Act of 2000, are discussed. That definition is limited in comparison to the CERG definition. For example, during CERG 2005, we identified that water (includes water provided by an irrigation organization or facility), power, sewer, wastewater treatment, communications, and emergency medical care are important. It may also be important to identify harbors, main roads, monitoring equipment, businesses, lighthouses, and airports as critical facilities. Transportation routes are particularly important because they can be used as routes to evacuate citizens and as routes to bring in supplies to the impacted area. A map of the critical facilities should be made so that all critical facilities are identified in one document. This document can be made in advance of a disaster; during a disaster it will be essential information. Critical facilities are a priority; assistance to a disaster impacted area will likely focus on repairing and maintaining critical facilities to help the citizens of the impacted area. Mapped information must be readily available to persons in the disaster impacted community and to persons around the world, in case disaster assistance is necessary from other nations.

Evaluating the building materials used for construction of both critical facilities and non-critical facilities is a crucial part of determining the likelihood of the structures to withstand impacts of the phenomena of the hazard. In addition, evaluation of the potential impacts to the non-structural components like the air, water, and vegetation of the area is important. Making a matrix, like the one in Figure 3, that includes phenomena listed in a column, with three columns of effects: the effects on population; the effects on physical consequences on construction like buildings and transportation facilities; and the effects on vegetation, water, and atmosphere, can give a community a clear idea of the impacts the phenomena could have to their community. Knowing what the community

has and how the community would be affected by hazards is essentially identifying the vulnerability of the community.

Within the CERG risk management framework, vulnerability was related to four main elements: 1) lifelines, equipment, buildings, 2) economic activities such as income created by agriculture or industry, government income, and informal sector, 3) social aspects, and 4) political and administrative aspects (Romerio, 2005).

A second matrix can be made then, like Figure 4, consisting of the levels of vulnerability, with the same headers of the previous matrix for effects on population; effects on construction like buildings and transportation facilities; and the effects on vegetation, water, and atmosphere. The vulnerability levels can be described qualitatively, estimated as a function of the physical consequences on these above described categories, due to the different phenomena.

The vulnerability can also be quantitatively estimated as a function of the physical consequences (if the quantitative data is available to make the mathematical analysis). For example, if a high level of contamination was considered to be over 200 ppm of a substance in the water, a medium level is 100 – 200 ppm, and a low level is less than 100 ppm, a quantitative evaluation of the impacts could be made. Both quantitative and qualitative evaluations of vulnerability provide useful information for risk management. If only qualitative information is available, the community may determine that obtaining quantitative information is important. In that case, the information should be collected and decisions should be made related to the thresholds for each level: the 100 ppm, the 100-200 ppm, and the greater than 200 ppm contamination levels described for the substance in the water.

Figure 3

Phenomena	Physical consequences on: Population	Constructions Buildings & transportation ways	Vegetation, water & atmosphere
Lava flows	burned out, buried cut by objects	B : burned out T : blocked	V : burned out
Pyroclastic flows	burned by clouds crushed	B : burned, damage, collapse T : blocked	V : burned out and flattened
Ash fall	asphyxiation	B : + rain = roofs collapse T : slippery roads	V : thin cover in agricultural fields, killing W & A : pollution
Gas	asphyxiation explosion, fire	B : corrosion	V : asphyxiation, burned out W & A : pollution
Landslides	buried cut by objects	B : displacement, damage, collapse T : blocked	V : flattened, destroyed, swept away
Rocks & blocks fall	crushed	B : damage, collapse T : roads blocked	V : flattened, destroyed, swept away
Debris flows & lahars	drowned burned by fire, buried	B : damage, collapse T : roads blocked	V : flattened, destroyed, swept away by flooding
Earthquake	crushed injured by objects	B : damage, collapse T : blocked	V : flattened, destroyed, swept away
Tsunami	drowned	B : flooding, damage, collapse T : harbors blocked	V : flattened, destroyed, swept away

Description of the physical consequences on population, constructions, vegetation, water and atmosphere as a function of each different phenomena observed iinhte Volcano Island.

Figure 4

Level	Population	Constructions Buildings & transportations ways	Water & air
1 high	gravely injured or dead	B : total collapse T :	W : contaminated, not potable A : contaminated, not breasable
2 medium	seriously injured	B : damage T :	W : partially contaminated but potable A : high concentration of toxic gases but breasable
3 low	minor / superficial injured	B : still standing T :	W : potable A : breasable

Vulnerability levels, qualitatively estimated as a function of the physical consequences on the population, constructions, water and air, due to the different phenomena

Perform a Risk Assessment and Identify the Management of the Hazard

The third component of the CERG hazard management framework is risk assessment. Risk assessment may include the need to assess the phenomena of the hazard as two events: rare and common. For example, the explosion of a volcano is a rare event. However, the lava flow and gas emission, for example, can occur without the explosion of the volcano, and can be considered as common events. The separation of the phenomena is based on frequency of occurrence of the event. It is useful to have this two-pronged view of the phenomena. The community may need to manage risk of the common and rare events differently. Therefore, activities to achieve a reduction of risk should be categorized and prioritized accordingly.

As discussed previously, risk is equal to the hazard multiplied by the vulnerability and the value. The risk matrix included below shows the high, medium, and low levels of risk. Again, the colors are the same as those used in the hazard and vulnerability matrixes: red represents the high risk, orange or blue represents the medium risk, and yellow represents the low risk.

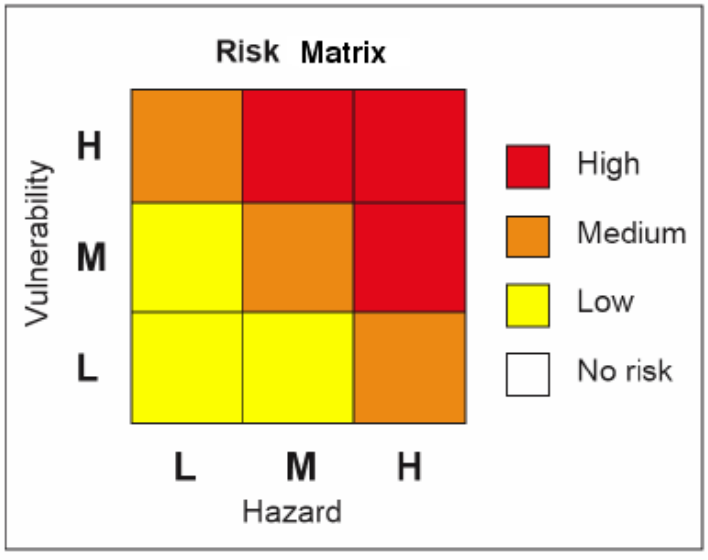


Figure 5

Risk levels. The red color represents a high level of risk, orange a medium level, yellow a low risk, and white no risk.

Identify How to Prevent and Prepare for Disasters (Risk Management)

The fourth component of the CERG hazard management framework is prevention and preparedness. It is also called risk management. Once the hazard, the vulnerability, and the risk have been identified, enough information has been collected to take steps to mitigate the level of risk. A determination of what is the level of acceptable risk has been made. Thus, the community is ready to take steps to prevent impacts from hazards and to be prepared for those impacts that do occur.

The definitions of prevention and preparedness are important to this discussion and are included here. Prevention "encompasses activities designed to provide permanent protection from disasters. It includes engineering and other physical protective measures, and also legislative measures controlling land use and urban planning. See also 'preparedness.'" Preparedness is "activities designed to minimize loss of life and damage, to organize the temporary removal of people and property from a threatened location and facilitate timely and effective rescue, relief, and rehabilitation. See also 'prevention'" (CERG 2005).

Prevention includes a wide range of measures such as an education program, building codes, and land use planning. These are large-scale prevention measures. Prevention is also implemented on a small scale. A community must prioritize the actions necessary to establish these prevention activities. For example, if there is an existing building code, perhaps it needs to be implemented more fully or perhaps it needs to be updated. In the community, is the priority to protect the existing or new structures? A jurisdiction might require changes to existing buildings when a person comes in to a building permit center to make changes to a building; at that time the building has to comply with a new requirement. A jurisdiction might have new buildings comply with structural strengthening measures. Both of these actions might be easier to implement instead of requiring all buildings to comply with the new rule by a certain date. Building requirements cover a broad range of structures. In some situations, a more narrow focus may be necessary, such as the community may need to focus on strengthening existing critical facilities, or moving them out of high-risk areas. Communication systems and information networks may need to be strengthened to withstand impacts. A determination of how strong the critical facilities should be – what level of risk is acceptable - must be made. Maintenance and monitoring programs may need to be established so that critical facilities are maintained to the fullest strength.

Preparedness activities include, for example, development of an early warning system, creation of an emergency operation center, establishing shelter, creating search and rescue teams, establishing medical assistance, and short-term and long-term development of financial assistance. These activities need to be prioritized. Development of what the short, medium, and long-term activities should be is important. For example, it might be important to install an early warning system and build emergency shelters as short-term activities. Mid-term activities could include equipping emergency crews with proper supplies, doing practice drills, and establishing evacuation routes. Long-term activities could be establishing a citizen education program and changing land use planning

regulations. In some communities, the level of acceptable risk is quite high. In these situations, the emphasis of risk management may need to focus on the fourth component of the CERG risk management framework; prevention may be made more difficult with a community that has a high level of acceptable risk. In this case, preparedness efforts may be the most effective.

Risk management encompasses both prevention and preparedness as discussed above. Since risk management includes prevention and preparedness, risk management includes solutions that will mitigate the consequences. The CERG risk management framework defines risk management with sustainable development in mind. The economic viability of a community must be considered as an essential part of prevention and preparedness. When making an assessment of hazards, vulnerability, and risk, economics is inherently part of that assessment. Recall that assessment of hazards, vulnerability, and risk involves an analysis of capacity. In that assessment process we understand what exists in the community and what can be lost as a result of a disaster. Development of a community is likely to continue in some manner related to the local economy; whether the economy revolves around selling fish or diamonds is irrelevant. Without development, a community does not survive. Recognizing that development is part of an economic system of a community allows us to consider how development can be sustainable and how development can better incorporate a risk management framework.

Natural hazards do not discriminate; however, the impacts to people vary greatly in terms of loss and the ability to recover from loss. In the U.S., FEMA statistics reveal that 80% of the burden of a disaster falls on the public. Minorities, children, and women carry a disproportionate amount of this burden. It is particularly important to identify the portions of the population that might be more at risk from a disaster. In Portland, Oregon, for example, 31% of the households are female-headed; 24% of the residents are below the age of 20; and 8% of the households are living below the poverty level (NHMP, 2-6). Prevention and preparedness activities can be designed appropriately with this information.

In the CERG risk management framework, risk includes an economic perspective with the risk identification (hazards, elements at risk, vulnerability, capacity, time, space), risk attitude, and risk management (ex ante and ex post). The economic perspective of risk, presented by Professor Romerio during the CERG program, is discussed below.

In this economic perspective of risk, the hazard still involves a probability of an event. The economic value of the element at risk is examined and an estimate of the economic vulnerability is made. What is the capacity of the community? Capacity is the ability of the community to cope with the disaster, as has been discussed. In the U.S., the term disaster-resistant communities has become commonplace. In fact, there is a national program established with parameters on how to become a disaster-resistant or disaster-resilient community. As part of the risk assessment, the time and space of the disaster must be determined. Is the timeframe of an event short-term, medium-term, or long-term? Risk management must involve short, medium, and long-term actions. What is the region, is it the local (micro) or national (macro) area? What is the risk attitude? As has

been discussed, there is a perception of risk, and it varies in each community for each hazard. Perception includes the filters of science, religion, the media, and culture. The perception of the risk may or may not be close to the reality of the risk.

To manage risk before an event is ex ante, and to manage risk after an event is ex post (Romerio). An identification of a hazard can be looked at in terms of a range - minor risk, major risk, and disaster – for example. A hazard can involve a large event or small repetitive events. There can be interactions of different types of phenomena or events; these interactions can result in a greater impact than the individual events. Disasters can be sudden or a slow developing events. As discussed earlier, risk can be estimated in a quantitative or qualitative method. There may or may not be any data available to quantify. Probabilities can be associated with an event, but for certain events, it is very difficult to estimate a probability of occurrence.

The risk attitude is described as the attitude towards risk; this attitude strongly influences experts, decision-makers, and citizens. Attitude may be based on scientific or subjective information. Attitudes and behaviors are part of the framework an individual invokes for decision-making. Individual and social behaviors are influenced by mental processes and by intrinsic motivations, emotions, perceptions, memory, and other factors. With risk management, there is an acceptability of risk. What is the acceptable risk in a given situation? I will briefly mention that there is a precaution principle related to risk management; it has to do with science and policy, and the perception of risk. The precaution principle has been a part of European environmental policies since the 1970s (Foster et al, 1). It is a principal to prevent harm to the environment and to human health (Rachel's, 1). The principle states that if there are threats to human health and the environment, then precautionary measures should be taken, even if the full cause and relationship has not be established (Rachel's, 2). Risk management analysis includes the price of prevention and the price of a disaster. There is a trade-off involved in management. Disaster has a price; to prevent it, a community must be willing to make choices, pay costs, and handle the consequences. A community must decide how much to pay before a disaster and how much to pay after a disaster. A community can compare choices for both situations; each choice related to a given situation has a trade-off (Romerio). The choices to be made are not easy choices.

"Collective risk management involves three public policies: risk identification (which includes individual perceptions, social representations, and objective assessment); risk reduction (or prevention/mitigation); and disaster management (response and recovery). Risk transfer (insurance and financial protection) comprises an additional policy measure, but significant advances have only been achieved in developed contexts... Risk reduction implies intervention in causal factors. Disaster management signifies an efficient response to risk that has materialized as disaster. Risk transfer implies risk evaluation of economic units. Therefore, risk management inevitably requires an understanding of how risk is perceived by society, how it is represented (models, maps, and indicators) and how it is measured or dimensioned" (*Mapping*, 40).

"In general, their approach suggests vulnerability has a social character and is not limited to the potential physical damage or to demographic determinants. It is stated that a disaster only takes place when the losses exceed the capacity of the population to support or resist them, or when the effects impede easy recovery. In other words, vulnerability cannot be defined or measured without reference to the capacity of a population to absorb, respond and recover from the impact of the event" (*Mapping*, 43).

I have discussed vulnerability and capacity, these terms will be discussed again with relationship to disaster resistance. When a community identifies the hazards that may affect them, and identifies the building materials of their structures and so forth, then the community also identifies what, if any, provisions are in place to be prepared for the hazards. As the CERG risk management framework describes, the community measures their vulnerability and capacity. What do they have and what will be lost from damage sustained in a disaster? The resistance of a community to a disaster relates to their vulnerability and capacity. In the U.S., as will described below, the use of the term disaster-resistant community has become commonplace. Another interesting view of disaster resistance includes the term survivability. This term is used in a discussion of critical infrastructure and security for energy. The term is relevant to our discussion because it also incorporates vulnerability and capacity. "Survivability is the ability of a system to fulfill its mission in a timely manner, despite attacks, failures, or accidents" (Farrell et al, 436).

A detailed description of the CERG risk management framework has been provided. Below, a description of the risk management framework at the City of Portland (as related to the NHMP), State of Oregon, and U.S. Federal government levels is provided. While not an exhaustive discussion, this information shows the complex regulatory relationship of risk management related to the City of Portland. The CERG risk management framework was presented during the CERG course as an internationally useful risk management framework for any given location.

How does the CERG risk management framework relate to the already existing situation at the City of Portland? To relate the CERG risk management framework to the City of Portland's Natural Hazard Mitigation Plan, we will look at the goals that were established by the NHMP. The NHMP is just one element in the City's risk management framework. A discussion of each of the City's NHMP goals in the terms of the CERG risk management framework provides a method to analyze how the City's NHMP relates to an internationally used risk management framework. The conclusion includes discussion of how the NHMP is realistic or idealistic, and whether the NHMP is adequate or should additional steps be taken to improve it.

City of Portland Natural Hazard Mitigation Plan, State of Oregon, Federal Regulations

City of Portland

The City of Portland, Oregon has a population of 529,121 (NHMP, 2-5) within the city limits, and a population of 1,444,219 (NHMP, 2-6) in the metropolitan area. In terms of population, Portland is the largest city in Oregon and is the 28th largest city in the U.S. (NHMP, Appendix C, 3). Two major rivers, the Columbia River and the Willamette River, meet in Portland. Portland is within a valley, with the Columbia River Gorge to the east and the Pacific Ocean to the west. Several large volcanoes surround the city, including Mt. St. Helens, Mt. Hood, and Mt. Adams. Both Mt. St. Helens and Mt. Hood are active volcanoes. In general, the seasons provide wet winters and dry summers.

Common natural hazards such as landslides, erosion, flooding, and liquefaction, relate to water retention and soil stability (NHMP, 2-4). Soil and mineral composition in the Portland metropolitan area vary substantially on the east and west sides of the Willamette River. In summary, they provide a basis for Portland to be subject to the aforementioned natural hazards. In addition, the majority of the Pacific Northwest part of the U.S. lies within the Cascadia Subduction Zone (NHMP 2-5). The Juan de Fuca and North American tectonic plates meet here; the convergence of these plates puts Portland and the entire Pacific Northwest at risk for a catastrophic earthquake of a magnitude 8.0 or higher (NHMP 2-5). The Portland Hills Fault, a fault located within Portland, is capable of generating moderately large earthquakes (NHMP 2-5).

The City of Portland has a risk management framework in place. These existing provisions have been established over the years as a result of risk management requirements from the Federal government, as well as from the State of Oregon. Some risk management framework elements have also stemmed from natural resource protection. In this paper, I focus on one part of the City of Portland's risk management framework, the Natural Hazard Mitigation Plan.

The City of Portland's NHMP was approved by the Portland City Council, the State of Oregon's Office of Emergency Management, and the Federal Emergency Management Agency (FEMA) on December 9, 2004. I will describe the components of the City of Portland's (also referred to as the City) Natural Hazard Mitigation Plan, its history, and how it will be implemented and maintained. In addition, the relationship of the City, State, and Federal regulations involved will be explained. A global perspective of risk management – the CERG risk management framework - is also described as it relates to the NHMP. As I have described, the CERG risk management framework can be applied to any global situation. When the CERG risk management framework is applied to the City's NHMP, is the NHMP consistent with the CERG risk management framework?

The City of Portland was required to write a Natural Hazard Mitigation Plan to comply with the requirements of the Federal Disaster Management Act of 2000 (DMA 2000). The writing of the City's NHMP was a collaborative effort, with the goal to reduce the loss of life and property in times of disasters. The loss of life and property in disasters are variable and unpredictable, but have been repeatedly demonstrated in devastating magnitude in events around the world in 2004 and 2005 - most notably the tsunami in the Indian Ocean in December 2004, Hurricane Katrina in the United States in August 2005, and the earthquake in Pakistan in October 2005.

Reduction and prevention of loss and life is often termed mitigation, as has been discussed. Prevention and preparedness, or risk management, is one of the four components of the risk management framework studied during the CERG program at the University of Geneva. Mitigation is part of risk management. Mitigation is a focus of both the Portland and the CERG risk management frameworks. Since mitigation actions take place in advance of disasters and establish measures to reduce and prevent loss of life and property, mitigation is the essence of a risk management framework.

The NHMP includes a statement defining natural hazard mitigation as a method permanently reducing or alleviating the losses of life, property, and injuries resulting from natural disasters through long and short-term strategies (NHMP, i). The dictionary defines mitigation as "to make less severe" (*Webster's*, 731). The risk management framework of CERG also includes definitions of mitigation, hazard, vulnerability, risk assessment, and risk management, as noted previously. In addition to the description of the City's NHMP, a discussion of how the four components of the CERG risk management framework relate to the City's NHMP is included.

The NHMP is organized into chapters; the chapters have subsections. For simplicity and clarity for the discussion to follow, these chapters and subsections are listed here.

Chapter I: Mitigation Action Plan
- Executive Summary: Five-Year Action Plan (includes action items matrix)
- Section I: Introduction
- Section 2: Community Profile
- Section 3: Risk Assessment Summary
- Section 4: Mitigation Plan Vision, Mission, Goals, and Action Items Overview
- Section 5: Multi-Hazard Action Items
- Section 6: Plan Implementation, Maintenance and Public Participation

Chapter II: Hazard Specific Information
- Section 7: Flood
- Section 8: Landslide
- Section 9: Earthquake
- Section 10: Extreme Weather
- Section 11: Wildfire

Chapter III: Resources
- Appendix A: Economic Analysis of Natural Hazard Mitigation Projects
- Appendix B: Documentation of Planning Process

Appendix C: City of Portland HAZUS-MH Risk Assessment Report

The NHMP Steering Committee began their work with a vision statement, then established the mission, the goals, and the action items (NHMP, 4-1). The City's efforts to develop the NHMP were extremely collaborative. In addition to the establishment of the Steering Committee, the City established five hazard-specific subcommittees comprised of City employees, citizens in community organizations and businesses, and regional and state agencies (NHMP, ii). The Steering Committee prioritized the goals and action items of the NHMP; these goals and action items will be implemented as the resources permit them to be (NHMP, v).

The vision statement is, "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" (NHMP, ii). This vision statement further articulates the City's vision to create a "Disaster Resilient City" (NHMP, ii and 4-1). A description of a Disaster Resilient City is provided under the "State of Oregon" section.

The goals of the NHMP were developed with the City of Portland Staff, citizens, and the NHMP's Steering Committee. The goals are based on the goals established by the State of Oregon's Natural Hazard Mitigation Plan (NHMP, 4-2). The City's mission is "to reduce risk, previous 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" (NHMP, iii). The goals to implement the City's mission include the following:

- Goal 1: Identify risk level and evaluate Portland's vulnerability to natural hazards.
- Goal 2: Implement activities to protect human life, property, and natural systems.
- Goal 3: 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.
- Goal 4: Establish a disaster resilient economy.
- Goal 5: Build and support the capacity and commitment to continuously become less vulnerable to hazards (NHMP, iii).

The NHMP has action items related to multi-hazard issues as well as the specific hazards identified by the City – earthquakes, landslides, floods, severe weather, and wildfire – that could potentially impact the City. The action items are primarily actions that the City of Portland Staff must take using their expertise in these areas. The action items are further described below. The risk assessment for the City identified the rank order of

threat to the City by the City's identified hazards – from low to severe threat - as earthquake, landslide, wildfire, flood, and severe weather (NHMP, iv).

Recall that the CERG risk management framework includes the essential four components: to identify the hazard (including the hazard phenomena), to identify the vulnerability, to perform a risk assessment and identify the management of the hazard, and to identify how to prevent and to prepare for disasters (risk management). Goal 1 of the City's NHMP relates to the first, second, and third components of the CERG risk management framework. In this goal, the City of Portland has identified the hazards, in order of low to severe threat, of earthquake, landslide, wildfire, flood, and severe weather. The vulnerability of the City as related to these hazards has been evaluated. The City performed a risk assessment. The City identified the management of the hazard. The second, third, fourth, and fifth goals of the City's NHMP are all related to the fourth component of the CERG risk management framework. The fourth component is risk management, or prevention and preparedness. Prevention and preparedness actions for the City are identified in the matrix called the "City of Portland Natural Hazard Mitigation Plan Action Items – Organized by Hazard" (NHMP, 1-8).

The prevention and preparedness action items are organized within the above noted matrix that lists multi-hazard and hazard-specific items (Appendix A). The following information is included for each action item: coordinating organization, internal partners, external partners, timeline, levels of immediate capability, ideas for implementation, and NHMP goals addressed. The timelines are established in short-term and long-term activities. Specifically, the short-term activities are the activities which City agencies are capable of implementing with existing resources and authorities within one to two years (NHMP, iv). The long-term activities are items that may require new or additional resources or authorities, and take between one to five years to implement (NHMP, iv). Each action item is associated with at least one goal of the NHMP (NHMP, iv).

The NHMP action items were prioritized initially, and a method of prioritization was also set up for the future. The initial prioritization of the action items is shown in the matrix. The first step was to prioritize the NHMP goals. Then, the identified hazards were prioritized based on the hazard risk assessments used in the City's HAZUS-MH project. The results of the first and second steps were used as a third step; in this step, each action item was "tallied according to a point system" to determine the relative priority of the action item within the NHMP (NHMP, 6-6).

The prioritization for determining action items for implementation in the future, includes the following information:

1) The prioritized Natural Hazard Mitigation Plan goals;
2) The degree of risk from the hazard;
3) The information in Portland's Risk Assessment;
4) The Capability Assessment Matrix included in the Plan (NHMP, 6-8).

The Disaster Policy Council and the Portland Office of Emergency Management are responsible for implementing the action items, as described below. The Steering Committee is part of the Disaster Policy Council; the Disaster Policy Council was established by a City of Portland ordinance effective on July 21, 2004 (NHMP, v).

The City of Portland's Office of Emergency Management Office (POEM) "provides planning, training, exercises and educational outreach programs related to natural and man-made disasters to assist and prepare citizens, government agencies, and private/nonprofit organizations prior to, during, and after a local emergency or disaster. The office also manages the City's Emergency Operations Center (EOC) during any major emergency or disaster and activates emergency warning systems. POEM works as an interagency coordinator in partnership with local, state, federal, and private entities to provide comprehensive planning, response, mitigation, and recovery capabilities for all hazard potentials facing the City of Portland" (http://www.portlandonline.com/oem).

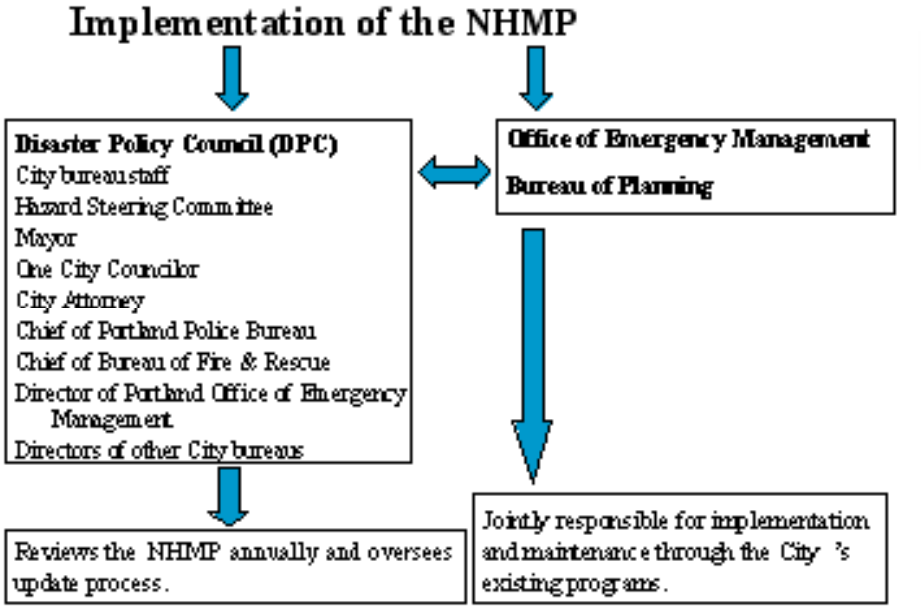
POEM directed and coordinated the writing of the NHMP. The director of the Oregon Natural Hazard Workshop (ONHW) at the University of Oregon acted as a consultant for the City on this endeavor. POEM and the City's Bureau of Planning are jointly responsible for implementing and maintaining the NHMP (NHMP, v). The Director of POEM will work with the Disaster Policy Council Chair to facilitate NHMP meetings (NHMP, vi). The Disaster Policy Council is the coordinating body for the NHMP (NHMP, v).

The implementation and evaluation of the NHMP will be shared among the members of the Disaster Policy Council (DPC) (NHMP, vi). The DPC consists of representatives from the City's bureaus, including but not limited to the current Hazard Mitigation Steering Committee members (NHMP, v). Specifically, the DPC consists of the Mayor, a City Commissioner, the City Attorney, the Chief of Portland Police Bureau, the Chief of the Bureau of Fire & Rescue, the Director of POEM, and the Directors of other City bureaus (NHMP, v). The flow chart below, in Figure 6, illustrates the links between the members of the DPC, the Staff of POEM, and the Staff of the Bureau of Planning; it also summarizes the responsibilities, in terms of the NHMP, of the respective DPC members and Staff.

The DPC provides advice and direction to the Director of POEM and the Director of the Bureau of Planning. The Director of POEM, the Director of the Bureau of Planning, and POEM Staff possess the main responsibilities of review, coordination, and promotion of the NHMP, to ensure the NHMP is implemented and maintained. POEM is responsible for contacting the DPC members and organizing the annual plan review meeting. The DPC members are responsible for the annual review and update of the NHMP. POEM will continue to identify ways for the public to provide input in implementation of and the updating of the NHMP. Public comments on the NHMP will be solicited through presentations to community organizations. The current version of the NHMP includes changes that were made between the date of approval on December 9, 2004 and the date of final publication in August 2005. Minor changes were made between the date of approval and the date of publication, based on comments from the City Commissioners

and updates from the NHMP subcommittees. For convenient public access, the NHMP is posted on the POEM website (www.portlandonline.com/oem). As of January 22, 2006, no comments have been received from the public to POEM about the NHMP (Reuter, personal communication).

Figure 6



Implementation of the NHMP is critical. The continued use of detailed hazard information collected during preparation of the NHMP, along with the knowledge of the NHMP collaborators, is important. Many people are invested in the NHMP and the citizens of Portland are clearly the benefactors of the work that has been done to date. People who live, work, and visit Portland benefit because the City has identified the hazards, and is better prepared for hazard impacts, including a disaster.

As stated in the NHMP, the NHMP is non-regulatory. The NHMP provides:

1) a foundation for the coordination and collaboration among agencies and the public in the City of Portland;
2) identification and prioritization of future mitigation activities, and;
3) assistance in meeting federal planning requirements and qualifying for assistance programs (NHMP, 1-2).

Is having a non-regulatory plan enough for a realistic and functional risk management framework? Will the action items be implemented? The NHMP must be reviewed every five years, in accordance with DMA. With regulatory obligations such as this, especially ones related to receiving funds from the Federal government, in addition to the emphasis

placed upon the prevention and preparedness action items, the reality is that the NHMP will be implemented.

With risk management, a community must look at the scientific data (frequency and magnitude of events), where the events occur, and the dramatic impacts (loss of life and property) of disasters. Globally, the total number of disasters increased from 368 in 1992 to 712 in 2001- an increase of 93% in one decade (*Mapping*, 2). With those disasters, the number of affected people increased from 78,292,000 people in 1992 to 170,478,000 in 2001 (*Mapping*, 2). Portland's 2001 risk assessment provided revealing information about the variety and severity of hazards Portland and the State of Oregon face. The State of Oregon received 12 of the 1,037 "major disaster declarations" in the U.S. between 1972 and 2000 (NHMP, 3-3). Oregon ranks 22nd out of the 50 U.S. states and numerous territories in the number of disaster declarations (NHMP, 3-3). Specific statistics related to each identified hazard and how it affects Portland are included below.

The City received funds from the Hazard Mitigation Grant Program and the Flood Mitigation Assistance Program – both are FEMA grant programs – to develop the NHMP (NHMP, i). In addition, the City of Portland provided money from the City's general fund for the NHMP (NHMP, i).

The City of Portland will implement the NHMP through existing programs and procedures. The City has numerous requirements to meet the State of Oregon Statewide Planning Goals and legislative requirements. The City has a comprehensive land use plan, capital improvement plans, City codes, non-regulatory projects, and non-regulatory programs. The NHMP includes recommended actions that correspond to the City's existing programs. The programs will provide opportunities for implementation of the NHMP. The City has increased the emphasis of risk management in recent years by creating the Portland Office of Emergency Management, and by focusing on increased public awareness of prevention and preparedness with citizens.

State of Oregon

The State of Oregon's Statewide Planning Goals were established by the 1973 Oregon legislature. Oregon's 19 Statewide Planning Goals identify the state's land use policies on transportation, ocean resources, and agriculture land as well as urbanization and other subjects. Compliance with the Statewide Planning Goals is mandatory in accordance with the Oregon Administrative Rules in Chapter 660, Division 15. The goals include guidelines and regulations. Guidelines are not mandatory; guidelines provide suggestions on how to apply the goals on a local level. Regulations are the implementation provisions of the planning goals. The responsibilities of the Oregon Land Conservation and Development Commission (LCDC) and the Department of Conservation and Development (DLCD) include adopting land use goals, assuring local plan compliance with state goals, coordinating state and local planning, and managing the coastal program. The seven members of the LCDC direct the work of the DLCD (www.ldc.state.or.us/lcdc).

The Statewide Planning Goals are achieved through the implementation of the goals as land use regulations at the local level. Cities and counties in Oregon are required by state law to have land use planning regulations that include zoning designations, land division ordinances, and a comprehensive plan. These are the tools of land use planning; they provide the parameters for deciding what uses and structures that may be allowed on any given piece of land in a jurisdiction. The LCDC reviews comprehensive plans for all jurisdictions in Oregon and acknowledges them for compliance with the Statewide Planning Goals. Coordination between agencies, at all levels of government, is an important part of implementing the Statewide Planning Goals.

Goal 7 of the Statewide Planning Goals is "Areas Subject to Natural Hazards." In essence, the goal states that development is not to be located or planned for areas that are in known areas of natural hazards without establishing relevant and appropriate standards. In accordance with Goal 7, "Local governments shall adopt comprehensive plans (inventories, policies, and implementing measures) to reduce risk to people and property from natural hazards." As defined by the State of Oregon, "Natural hazards for the purposes of this goal are floods (coastal and riverine), landslides, earthquakes and related hazards, tsunamis, coastal erosion, and wildfires. Local governments may identify and plan for other natural hazards" (www.lcd.state.or.us/goalhtml/goals.html). Goal 7 requires local agencies – that is cities, counties, and special districts – to inventory hazard areas.

Identification and inventory of hazard areas is a key element to reduce the impacts of hazards to life and property. By avoiding or reducing development in hazard areas, impacts to life and property can be avoided or reduced. Once hazard areas are mapped, consequences or impacts of hazards can be evaluated and risk can be assessed. Actions for risk management can be implemented through land use planning. Land use planning is an integral part of risk management. In Oregon, risk management and land use planning regulations have been in effect over 30 years. Federal hazard planning and risk management regulations have existed for over 30 years. The first Federal hazard planning regulations were put into law with the Robert T. Stafford Disaster Relief and Emergency Assistance Act in 1974 (http://www.fema.gov/library.stafact.shtm #1). The Disaster Management Act (DMA 2000) updated this law.

DMA 2000 focuses on making communities disaster resilient communities as described below. Recall that the City of Portland's NHMP Goal 4 is "Establish a disaster resilient economy." Goal 4 was purposely established to link the City's NHMP to the State of Oregon Natural Hazard Mitigation Plan. The State of Oregon has had disaster mitigation plans since the mid-1990's. The most recent State of Oregon NHMP includes the ideas of the Partners for Disaster Resistance and Resilience program. As explained below, the program is not a regulatory program; it is not required by the Federal government. The program is voluntary and established through partnerships and a desire to mitigate disaster. With the State of Oregon leading the way, in both a regulatory and motivational way, the local jurisdictions can follow. The primary responsibility of risk reduction is with the local jurisdiction. While the City of Portland is not an officially sanctioned Disaster Resilient City, as defined by the Partners for Disaster Resistance and Resilience

program (no cities in Oregon are), there is a definite intention by the City of Portland to link the State of Oregon and City of Portland NHMP's. (LeDuc, personal communication).

The City of Portland's NHMP planning process was designed to "1) result in a plan that is DMA 2000 compliant; 2) coordinate this plan with the State's Natural Hazard Mitigation Plan and Partners for Disaster Resistance and Resilience: Oregon Showcase State Initiative; and 3) build a network within the City government and organizations that can play an active role in plan implementation" (NHMP, 1-4).

The identified natural hazards in Oregon include: tsunamis, volcanic hazards, winter storms, wind storms, landslide and debris flows, floods, fire (specifically at the urban/ wildland interface), El Nino/La Nina, earthquakes, dust storms, drought, and coastal erosion (http://www.oregonshowcase.org/).

On December 12, 2000, Governor Kitzhaber issued an Executive Order designating Oregon as a "Showcase State for Natural Disaster Risk Reduction." The Partners for Disaster Resistance and Resilience (PDRR): Oregon Showcase State" program is modeled after a program in Rhode Island that occurred in 1998. That program was initiated by the insurance industry to "reduce deaths, injuries, property damage, economic loss, and human suffering caused by natural disasters." The focus of this partnership of government and the private sector is to have a comprehensive, cost-effective partnership where partners can bring together human and financial resources to prepare for and minimize disaster in Oregon (http://www.oregonshowcase.org/).

The partnership includes the Governor's Interagency Hazard Mitigation Team (GIHMT), the Insurance Information Service of Oregon and Idaho, and the Oregon Natural Hazards Workshop (ONHW) at the University of Oregon. ONHW is the lead organization: ONHW serves as the coordinator, facilitator, and implementing organization for the program (http://www.oregonshowcase.org/).

The ONHW has several responsibilities, including:

> "Coordinate the Partners for Disaster Resistance: Oregon Showcase State Program and develop an Oregon Natural Hazards Internet Resource web page to effectively use technology to share information and resources, both applied and educational, that will assist communities, organizations, and citizens in reducing property and infrastructure damage and deaths from natural hazards in Oregon;" (www.darkwing.uoregon.edu/onhw/text/about/tabout.html).

The ONHW provided technical assistance with the natural hazard mitigation plans in several Oregon communities, in addition to the City of Portland. Specific projects by ONHW include: the *State Natural Hazard Assessment for the State Hazard Mitigation Plan, Oregon*; *Planning for Natural Hazards: Oregon Technical Resource Guide*; and the *Oregon, Local Natural Hazard Mitigation Plans: An Evaluation Process* (www.darkwing.uoregon.edu/onhw/text/about/tabout.html).

Activities of the Partners for Disaster Resistance: Oregon Showcase State Program will be implemented through the Partners for Disaster Resistance Five Year Strategic Plan. The vision of this Strategic Plan is illustrated through the goals and actions that support the 14 Showcase State program model elements listed below. One goal of the program is to develop strategies to provide Oregon with a more effective and holistic approach to natural hazard management. Instead of examining portions of disaster planning – most commonly the reactive, recovery portion – the program considers all the components of natural hazard management. There are three basic questions to consider in developing a strategic plan: 1) Where are we now?, 2) Where are we going?, and 3) How are we going to get there?. The strategic plan uses the baseline of activities that currently exist in Oregon, including the preparedness and risk reduction activities, and uses the perceived level of risk (http://www.oregonshowcase.org/).

There are 14 elements for the Showcase State model:

1) Formal commitment and strategic plan: Obtain Governor-level executive order to formalize partnership. Create 5-year with 1-year action plans.
2) Statewide hazard and risk assessment: Identify hazards and what's at risk statewide to help prioritize disaster-resistant actions.
3) Business recovery alliances: Develop partnerships with businesses for coordinated mitigation, preparedness, response, and recovery.
4) Enforceable building code: Adopt and enforce a statewide model code that incorporates hazard-resistant design.
5) Land use plans: Address relevant hazards in state-level land use decisions. Encourage adoption of local plans that incorporates hazards and mitigation strategies.
6) Response and recovery plans: Maintain a state emergency response plan. Develop a state post-disaster recovery plan coordinated with local post-disaster plans.
7) Rating and regulatory systems: Improve compliance and participation in natural hazard-related rating and regulatory systems (e.g. National Flood Insurance Program, Community Rating System, Fire Suppression Rating, Building Code Effectiveness Grading Schedule, etc).
8) Lifeline protection: Incorporate disaster protection measures into public and private lifeline utilities, infrastructure, and critical facilities.
9) Community level disaster assistance: Encourage the development of disaster resistant communities within the state and coordinate at local and regional levels.
10) Public awareness and outreach: Develop programs to increase the public's awareness of natural hazards and how to reduce or prevent damage.
11) School curricula: Incorporate natural hazard awareness and reduction programs into grade school and higher education curricula.
12) Protection of child care centers: Support the Institute for Business & Home Safety and its partners in the nonstructural retrofit of nonprofit childcare centers.

13) Professional training: Conduct mitigation training for building design and construction professionals and others to incorporate disaster resistance into policy and practice.
14) Incentives and disincentives: Identify existing incentives and disincentives for hazard loss reduction action. Develop and enact appropriate incentives or adjustments (http://www.oregonshowcase.org/).

Federal Regulations

The Disaster Relief Act of 1974 or the Robert T. Stafford Disaster Relief and Emergency Assistance Act is also known as Public Law 93-288. It was approved on May 22, 1974 (www.fema.gov/library/stafact.shtm#1). The Disaster Relief Act stated, "It is the intent of the Congress, by this Act, to provide an orderly and continuing means of assistance by the Federal Government to State and local governments in carrying out their responsibilities to alleviate the suffering and damage which result from such disasters" (www.fema.gov/library/stafact.shtm#1). The Disaster Relief Act was the first piece Federal legislation for disaster relief, and it included the definitions of emergency and major disaster.

"Emergency means any occasion or instance for which, in the determination of the President, Federal assistance is needed to supplement State and local efforts and capabilities to save lives and to protect property and public health and safety, or to lessen or avert the threat of a catastrophe in any part of the United States.

Major disaster means any natural catastrophe (including any hurricane, tornado, storm, high water, wind driven water, tidal wave, tsunami, earthquake, volcanic eruption, landslide, mudslide, snowstorm, or drought), or, regardless of cause, any fire, flood, or explosion, in any part of the United States, which in the determination of the President causes damage of sufficient severity and magnitude to warrant major disaster assistance under this Act to supplement the efforts and available resources of States, local governments, and disaster relief organizations in alleviating the damage, loss, hardship, or suffering caused thereby" (114 Stat. 5122).

The Disaster Management Act of 2000 (DMA) is also known as Public Law 106-390 and was approved on October 30, 2000 (DMA, 114 Stat. 1552). The 106th Congress of the United States passed the DMA "to amend the Robert T. Stafford Disaster Relief and Emergency Assistance Act to authorize a program for pre-disaster mitigation, to streamline the administration of disaster relief, to control the Federal costs of disaster assistance, and for other purposes" (DMA, 114 Stat. 1552).

There are three sections of the DMA: Title I – Pre-disaster Hazard Mitigation, Title II – Streamlining and Cost Reduction, and Title III – Miscellaneous. The purpose of the DMA is to establish a disaster hazard mitigation program. The focus is twofold: 1) "to reduce the loss of life and property, human suffering, economic disruption, and disaster assistance costs resulting from natural disasters" and 2) "to provide a source of pre-disaster hazard mitigation funding that will assist States and local governments (including

Indian tribes) in implementing effective hazard mitigation measures that are now designed to ensure the continued functionality of critical services and facilities after a natural disaster" (DMA, 114 Stat. 1553).

The reasons provided by the 106th Congress for changing the existing law include:

1) "Natural disasters, including earthquakes, tsunamis, tornadoes, hurricanes, flooding, and wildfires, pose great danger to human life and to property throughout the United States,"

2) "Great emphasis needs to be placed on a) identifying and assessing the risks to States and local governments (including Indian tribes) from natural disasters b) implementing adequate measures to reduce losses from natural disasters c) ensuring that the critical services and facilities of communities will continue to function after a natural disaster,"

3) "Expenditures for post disaster assistance are increasing without commensurate reductions in the likelihood of future losses from natural disasters,"

4) "In the expenditure of Federal funds under the Robert T. Stafford Disaster Relief and Emergency Assistance Act (42 U.S.C. 5121 et seq.), high priority should be given to mitigation of hazards at the local level,"

5) "With a unified effort of economic incentives, awareness and education, technical assistance, and demonstrated Federal support, States and local governments (including Indian tribes) will be able to a) form effective community-based partnerships for hazard mitigation purposes b) implement effective hazard mitigation measures that reduce the potential damage from natural disasters c) ensure continued functionality of critical services d) leverage additional non-Federal resources in meeting natural disaster resistance goals e) make commitments to long-term hazard mitigation efforts to be applied to new and existing structures" (DMA, 114 Stat. 1553).

The DMA 2000 required all jurisdictions to submit a mitigation plan to the Federal government by November 2004 (Lagomarsino) to be considered in compliance with DMA. DMA requires local plans to be updated every five years. As stated in DMA, "As a condition of receipt of an increased Federal share for hazard mitigation measures under subsection (e), a state, local, or tribal government shall develop and submit for approval to the President a mitigation plan that outlines processes for identifying natural hazards, risks, and vulnerabilities of the area under the jurisdiction of the government" (DMA, 114 Stat. 1558).

The submitted mitigation plans must demonstrate that the proposed mitigation measures are based on a sound planning process that accounts for the risk to the individual and their capabilities. DMA requires risk to be assessed qualitatively (e.g. high, medium, low) and, if possible, quantitatively (NHMP, Appendix C, xi). If a local jurisdiction does not

comply with DMA 2000, then the jurisdiction is not eligible for post disaster relief funds from the Hazard Mitigation Grant Program and the Flood Mitigation Assistance program when the area is declared a Federal Disaster Area. With compliance with DMA 2000, the jurisdiction is eligible for funds from the Pre-Disaster Mitigation Grant Program, the Hazard Mitigation Grant Program, and the Flood Mitigation Assistance program. (NHMP, 1-3). The DMA requirement for qualitative and quantitative risk assessment relates to the CERG risk management framework, particularly the identification of vulnerability.

The DMA 2000 established a Pre-Disaster Mitigation Program. The Pre-Disaster Mitigation Program allows the President "to establish a program to provide technical and financial assistance to states and local governments to assist in the implementation of pre-disaster hazard mitigation measures that are cost-effective and are designed to reduce injuries, loss of life, and damage and destruction of property, including damage to critical services and facilities under the jurisdiction of the states or local governments" (DMA, 114 Stat. 1554). DMA established new requirements for the existing post-disaster Hazard Mitigation Grant Program (NHMP, 1-3). Section 322 of DMA specifically provides that funds from the Hazard Mitigation Grant Program can be used for planning activities, and it increases the amount of funds available from the Hazard Mitigation Grant Program (NHMP, 1-3). Section 322 requires that the risk assessment, done as part of a community's hazard mitigation plan, must include hazard identification, profiling hazard events, vulnerability assessment/ inventorying assets, risk analysis/estimating potential losses, and assessing vulnerability/ analyzing development trends (NHMP, 3-1 and 3-2). A community must have an approved NHMP to be eligible for funds from the Hazard Mitigation Grant Program. Again, the requirements of DMA relate to the CERG risk management framework components.

City, State, and Federal regulations all have the goal to reduce negative impacts on life and property by identifying the hazard, identifying the vulnerability, performing a risk assessment, and doing risk management. As mentioned previously, definitions for terms used are important. Definitions are important for examining the regulations within a specific country, as we have done, but are particularly important for examining the regulations and situations on an international level. To have the CERG risk management framework be readily applicable to a situation in any nation, the terms like hazard, vulnerability, risk, prevention, and preparedness, must be similarly defined in Switzerland, Algeria, Sri Lanka, the U.S, and all nations.

Of note for risk management purposes is the definition for critical services in the U.S. under the DMA. Critical services include water (includes water provided by an irrigation organization or facility), power, sewer, wastewater treatment, communications, and emergency medical care (DMA, 114 Stat. 1562). Transportation is not included in the DMA definition of critical services. This is a notable exception! Without transportation - roads, bridges, boats, trains, airplanes, cars and so forth - it may be difficult to evacuate people from the impacted areas, and to bring aid to people within the impacted areas. How do you easily get water or emergency medical care to people without transportation? In the CERG risk management framework, described in detail above,

transportation is a critical facility. In the City of Portland's NHMP, transportation is a critical facility (NHMP, 2-12).

For the City's risk assessment, critical facilities include hospitals, schools, fire stations, police stations, hazardous materials sites, transportation systems, high-potential loss facilities, and lifeline utility systems (NHMP, 2-12). Critical infrastructures include "the public services that have a direct impact to the quality of life;" and these include public water supplies, sewer treatment facilities, transportation facilities (railways, bridges, airports, heliports, tunnels, harbors, canals, and so forth (NHMP, 2-12). Lifelines are utility systems like potable water, electric power, communication systems, and transportation facilities (NHMP, 2-12). High-potential loss facilities are facilities that would have a high loss associated with them; for example, dams, military installations, and nuclear power plants (NHMP, 2-12).

It is generally accepted that no critical facilities like hospitals or communications facilities should be constructed in hazard areas. However, in many situations, the existing facilities such as hospitals and communications existed prior to the hazard being identified. It is too expensive to relocate existing facilities in many situations. As much as practicably possible in these situations, new facilities should be located outside of the hazard areas. Existing facilities should have back-up or alternative facilities in other locations, preferably outside of the hazard areas. The back-up facilities should provide the same services of the main critical facilities.

A monitoring and maintenance system for these critical facilities should be established. Monitoring and maintenance systems include an evaluation of the condition of all the critical facilities, perhaps on a yearly basis. When the facilities are monitored, normal maintenance can be accomplished more readily, early detection of problems can occur, and problems can be repaired when they are discovered. Unfortunately, there are many reasons why neither monitoring nor maintenance occurs, or where monitoring does not necessarily mean that maintenance will occur. Typically, political will is a major determinant of the success of monitoring and maintenance of critical systems. In the U.S., this is especially true when municipalities with tight budgets are faced with more "immediate" pressures such as funding education, roads, and so forth. As we have learned in the case of Hurricane Katrina, the monitoring of the condition of the levees in the New Orleans did not lead to the accomplishment of appropriate levee repair. In the tsunami in the Indian Ocean in December 2004, not all of the affected countries had tsunami monitoring systems and systems to share information. As a result, warnings that a tsunami was forthcoming were not passed along to the affected people.

When a disaster occurs, the tendency is for a quick re-establishment of buildings and activities that occurred in the area before the disaster occurred. It is easy to understand why people want to return to what they know, what they know is normal and more comfortable. It is important to consider the post-disaster situation before re-establishing the buildings and activities. It may be prudent to not rehabilitate an area in the exact location. Regulations can help provide options that make decisions easier. For example, allowing the use of Federal money to relocate buildings and activities in different areas.

The idea of not repairing, restoring, restructuring, or replacing a failed public facility because of an area being too unstable or unsafe such that it is unfeasible to do the repairing, restoring, restructuring, or replacing, is not a new one. DMA 2000 specifically identifies that 90% of the money the Federal government would provide for the repairing, restoring, restructuring, and replacing, could be received. In the U.S. in 1993, the floods in the Midwest were so devastating that several towns were relocated. FEMA would not grant money to rebuild in the same location. FEMA made a bold policy decision.

One aspect of prevention and preparedness, or risk management, is rehabilitation (see previously included definition of preparedness). This rehabilitation, which, in theory, will be made easier by taking appropriate mitigation efforts, includes response and recovery. Response and recovery was not covered in detail by the CERG risk management framework, nor is it covered in detail by the City's NHMP. One source of information that I consulted describes that emergency management people classify emergency management in four phases: mitigation, preparedness, response, and recovery (Lagomarsino). Definitions of mitigation and preparedness have already been included in this paper. Response is defined as, "includes actions taken to provide emergency assistance, save lives, minimize property damage, and speed recovery immediately following a disaster" and recovery is defined as, "includes actions taken to return to a normal or improved operating condition following a disaster" (Lagomarsino). These definitions relate to vulnerability, capacity, and disaster resilience.

One recent report published in the U.S. discusses a national strategy for disaster reduction. In June 2005 the report, "Grand Challenges for Disaster Reduction," was published by the National Science and Technology Council, Committee on Environment and Natural Resources, the Subcommittee on Disaster Reduction (SDR). SDR is an element of the President's National Science and Technology Council (NSTC) (*Grand Challenges*, intro letter). Representing a collaboration of 20 Federal agencies with disaster reduction missions, SDR facilitates the national strategies to effectively use science and technology to reduce disasters (*Grand Challenges*, intro letter).

Science is important. To integrate science and the social, environmental, and political parameters, is the crux of risk management. Science is often the basis for land use policy, yet policy develops the science that is pursued. The fusion of science and policy is inherently complex. The Federal government and the State of Oregon often mandate the implementation of regulations at the local level. Change must occur in the societal perception of risk and in the perception of risk by policy-makers. People must be willing to adapt to advances of science and technology, and be open to understanding the social, environmental, economic, and political parameters of a given community.

We must understand both science and society (e.g. policy-makers, researchers, citizens) with risk management. Within a risk management framework we must be able to communicate to citizens, policy-makers, researchers and so forth. To write and speak well is essential. All the science and all the policies will not connect unless we connect them, and to make the connections and build the relationships, we must communicate

effectively. We must understand society. For example, we see patterns of disasters like the tsunami in the Indian Ocean in December 2004 and Hurricane Katrina in August 2005. In these disasters, not enough people were warned in a timely manner, and of those that were warned, many people remained in the hazard area. Sometimes people believe they have nothing to lose by remaining in the area they know, they don't believe there is a hazard, they have no where to go, they have no method of transportation to go to a safe place, or they have no money to pay for transportation or lodging in another location. This is an area of much research, how people react and respond in these situations. I will leave this topic for those research papers to be written, with a comment to say that I think exploration of the topic is critical. We must acknowledge here that the framework of society is inseparable from our analysis of hazard, vulnerability, risk assessment, and risk management. There are societal constraints; we must recognize them, acknowledge them, and formulate action related to them with respect to the uniqueness of each community. We apply the CERG risk management framework with the local area in mind. To apply the framework locally, we must understand the local area in terms of the political, social, economic, and environmental constraints.

Land use planning is an avenue for communities to determine what is important to the members of the community. Land use planning is the interaction of multiple disciplines working to protect, create, and establish livable environments in urban and rural communities. (Sears, 1 - 2). In the context of natural hazards, it is important that a community: identify what hazards exist; identify the nature and extent of the hazards; assess the risk to the community; and finally, establish parameters about what is acceptable development in the hazard areas. Considerations include the data that are available, the frequency with which a hazard event occurs, and the acceptable risk. Each community will choose how to use data; judgment on how to apply the data will vary in each community. Technically sound information must be available because accuracy in identifying the hazard is critical to the decision-making process when determining acceptable risk. Risk management is often implemented through land use planning, as I discussed earlier. Therefore, land use planning is a necessary part of the decision-making process; it can reduce loss or damage to people and property by avoiding and reducing development in hazard areas.

This discussion focuses on benefits of reducing impacts to life and property in terms of a legal risk management framework with City, State, and Federal regulations. There is always, in legal frameworks, the threat of litigation. "Failure to recognize a hazard in the contemporary legal atmosphere of the United States probably constitutes negligence and the risk of legal proceedings. Once the hazards have been recognized, the first step in the process is to evaluate each hazard and the associated risk. Hazard evaluation involves the quantification of the probability of occurrence of the event at an intensity which exceeds the damage threshold (exceedance probability) within a specified exposure time (design life). Evaluation of the risk includes an inventory of the population, property, and business functions that may be injured, damaged, or disrupted should a hazard event of specified intensity occur. Once both the hazard and the risk has been evaluated, the level of allowable or acceptable risk must be established. This step is a critical public policy or

private financial decision that influences the entire hazard management program" (Sears, 3).

Land use planning is a means to implement or apply information. Having the best and most accurate information is desirable. How do you use this information? How do you assess and quantify data into an objective format? You make judgments to use, discard, shape information into the objective format. With communities determining what is acceptable risk, there is also judgment involved. Mapping, for example, involves a quantification of data in a visual method. There is a quantification of susceptibility that is inherent in mapping – you draw lines around certain areas to identify levels of hazard or vulnerability for example - and susceptibility is a part of risk. Not all the parties involved may accept that judgment made by others such as the researchers, citizens, or policy-makers. Therefore, some level of compromise and trade-off may be used to achieve the implementation of scientific data. The involved parties will invoke their risk attitude. As discussed previously, the attitudes and behaviors of people are influenced by mental processes, intrinsic motivations, perceptions, memory, and other things. Science and policy involve judgment, and they are fused in application through land use planning.
Return now to the Federal "Grand Challenges of Disaster Reduction" document. The members of SDR were challenged to develop a ten-year strategy for disaster reduction through science and technology. To accomplish a comprehensive approach, the members of SDR collaborated with scientists and engineers around the world. The result was an identification of "grand challenges" for disaster reduction. These six grand challenges are described, along with a framework to prioritize Federal investments in science and technology to achieve disaster reduction (*Grand Challenges*, letter).

Facts and figures related to the cost of disasters in the United States are startling high. Natural and technological disasters, estimated to cost $1 billion dollars per week, take the form of lives lost, along with public and private properties destroyed. In 2004, for example, there were more than 60 disasters in the United States including floods, hurricanes, wildfires, tornadoes, and earthquakes (*Grand Challenges*, letter).

The challenge, as has been repeatedly stated, is to reduce lives lost, and to reduce the loss of public and private properties. To do so, the U.S. government has focused efforts on community level action so that communities reduce the cycle of destruction and recovery by becoming more disaster resilient. Disaster resilience is defined as "the capacity of a system, community, or society potentially exposed to hazards to adapt, by resisting or changing, in order to reach and maintain an acceptable level of functioning and structure. This is determined by the degree to which the social system is capable of organizing itself to increase its capacity for learning from past disasters for better future protection and to improve risk reduction measures" (*Grand Challenges*, Appendix B). In summary, each community must know its capacity to prepare, mitigate, respond, and recover. Disaster resilient communities, then, will reduce the potentially severe impacts from technological and natural disasters. The Subcommittee on Disaster Reduction has identified key characteristics of disaster resilient communities:

- Relevant hazards are recognized and understood;

- Communities at risk know when a hazard event is imminent;
- Individuals at risk are safe from hazards in their homes and places of work;
- Disaster resilient communities experience minimum disruption to life and economy after a hazard event has passed (*Grand Challenges*, 1).

On a related note, the State of Oregon has also focused on making disaster resilient communities. The "Partners for Disaster Resistance and Resilience: Oregon Showcase State" program encompasses the four key characteristics of disaster resilient communities identified by the SDR; the program was described earlier. First, the six Grand Challenges identified by SDR are listed and described in the following paragraphs. Within each Grand Challenge, there are challenges, key research requirements, and major technology investments. To continue the discussion of the CERG risk management framework as it relates to the risk management framework of the City of Portland, each Grand Challenge includes comments about the CERG risk management framework. For this discussion, the term U.S. is universal to include people at the local, State, and Federal level.

Grand Challenge #1*: Provide Hazard and Disaster Information Where and When it is Needed.* Developing tools for emergency managers, fire responders, scientists, citizens, and policy-makers is critical to our ability to plan for and to respond to natural and technological disasters. The ability to identify and anticipate hazards, to have real time data, and to interpret the data, is essential to the aforementioned people (*Grand Challenges*, 6).

To accomplish Grand Challenge #1, there are two challenges identified by SDR as key: 1) improve data collection to increase understanding of the ways in which hazards evolve, and 2) create standards for sharing, storing, and analyzing data. To improve data collection the U.S. will use sensors and other tools to obtain information; real-time data will provide essential information for prompt responses. The U.S. must create standards for sharing and storing information so that information can be rapidly transferred to people such as researchers and emergency managers (*Grand Challenges*, 6).

Key research requirements include, for example, developing a protocol for a searchable, all-hazards, internet accessible data system. Major technology investments include, for example, incorporating geographical location data into systems that provide real-time, high quality, integrated social and environmental information for emergency response (*Grand Challenges*, 6). This Grand Challenge collects and disseminates information quickly through the use of highly developed computer technology. In terms of the CERG risk management framework, this Grand Challenge is most related to the first component, to identify the hazard (including the hazard phenomena).

Grand Challenge #2: *Understand the Natural Processes that Produce Hazards*. Improving forecasting and prediction about natural hazards is of obvious importance. Scientists must continue to research what hazards affect an area, the natural processes that produce the hazards, when they occur, when they affect us, and how they affect us (*Grand Challenges*, 7).

Prediction of hazards is a widely desired use of information that has been gathered for a hazard. A forecast is a specific type of prediction. Some hazards have more information available that can be quantified and qualified. An abundance of detailed information is useful. Yet forecasting maybe unrealistic. Forecasting, that is speculating, for example, when a debris flow will occur at the level of estimating a specific date and time it will occur, is an unrealistic expectation. It is too complicated to fully know when the factors will coalesce into a hazard. Diagnostic tools such as maps lend themselves to limited attempts at prediction of events. The prediction of a debris flow, for example, involves no time certain; the debris flow will occur based on numerous factors and the factors give information regarding its likelihood. The likelihood is a function of many factors. As described by the CERG risk management framework, specifically within the identification of vulnerability, the qualification and quantification of data is important. We did not study forecasting hazard events.

The Grand Challenge document identifies one challenge for the Grand Challenge #2. That challenge is to improve models and visualization techniques. The improved models and visualization techniques will make data more usable for such areas of study as geology, meteorology, resource management, and social sciences. Hazards are dynamic and the data must be dynamic and accessible (*Grand Challenges*, 7).

Key research requirements to achieve improvements described above include improving data collection and observations of hazard-related processes, and creating and accelerating improvements of models of physical, chemical, and biological processes. These models enable a greater understanding of the interrelationship of hazards. The major technology investments needed include expanding and improving the network that provides access to computational and simulation resources for analysis and predication (*Grand Challenges*, 7). The CERG risk management framework component most related to this Grand Challenge is the first component, to identify the hazard. Like Grand Challenge #1, Grand Challenge #2, uses highly developed computer technology for the collection and distribution of information about hazards.

Grand Challenge #3*: Develop Hazard Mitigation Strategies and Technologies*. If the U.S. wishes to reduce damage from natural and technological disasters, the U.S. must have mitigation strategies that can be understood and can be implemented. The U.S. must use the collected scientific data in a manner that reduces damage. Strategies for hazard mitigation include land use planning regulations that recognize the location and risks of natural disasters. Implementing building regulations that require disaster resilient materials to be used is another strategy. Locating structures in appropriate places and constructing structures to withstand hazards is also a disaster reduction method (*Grand Challenges*, 8). This relates to the CERG components of the identification of vulnerability, the risk assessment, and the risk management.

There are three challenges for Grand Challenge #3: 1) create resilient structures and infrastructure systems using advanced building technologies; 2) support structural advances with effective non-structural mitigation; and 3) quantify the monetary benefits of disaster mitigation using economic modeling. For the first challenge, the resilient

infrastructure systems will use materials that can withstand the impacts of hazards. For the second challenge, the advances in structural materials must be accompanied by appropriate non-structural measures such as land use planning regulations. The regulations should use geological, climatological, and other information as much as possible. For the third challenge, modeling should be done to show that investing at both local and national levels in disaster mitigation policies prior to investing in mitigation projects can provide substantial savings (*Grand Challenges*, 8).

The Multihazard Mitigation Council (MMC) of the National Institute of Building Sciences released to FEMA the study "Natural Hazard Mitigation Saves: An Independent Study to Assess the Future Savings from Mitigation Activities" in December 2005 (Natural Hazards Observer, 1). Congress mandated the independent, three-year study. The study examined 10 years of FEMA mitigation grants (1993-2003); it consisted of statistical analysis and community analysis. Across all the grants, regions, and hazards studied, the MMC found that for each dollar spent on mitigation, society saves $4 in avoided future losses (Natural Hazards Observer, 1). The results of the study also revealed that FEMA mitigation grants play a significant role in the mitigation activities in the communities, and often lead to additional loss activities. Based on the eight communities studied, "Most interviewees believed that the grants permitted their communities to attain mitigation goals that might not otherwise have been reached and that the mitigation benefits of the activities funded by the grants went beyond what could actually be measured quantitatively (e.g. increased community awareness, esprit de corps, and peace of mind)" (Natural Hazards Observer, 3).

The MMC made three recommendations based on the study.

- The first is that the nation will "be vulnerable to natural hazards; therefore, it is only prudent to invest in mitigation. Mitigation is sufficiently cost- effective to warrant Federal funding on an on-going basis both before disasters and during post-disaster recovery."
- The second is that "mitigation is most effective when carried out on a comprehensive, community-wide, and long-term basis."
- Third, "continuing analysis of the effectiveness of mitigation activities is essential for building disaster resistant communities. The need to integrate social science research into traditional hazard mitigation is strongly encouraged" (Natural Hazards Observer, 3).

The key research requirements for Grand Challenge #3, for example, will encourage investment in developing, modeling, and monitoring impacts of cost-effective and beneficial mitigation technologies. No major technology investment was identified (*Grand Challenges*, 8). Grand Challenge #3 is most related to the CERG risk management framework component of risk management, also known as prevention and preparation.

Grand Challenge #4: *Recognize and Reduce Vulnerability of Interdependent Critical Infrastructure*. The U.S. must protect our critical infrastructure systems, our lifelines in our communities. To be fully prepared, the U.S. must identify what these systems are

and where they are located in our communities. Such systems include communications, financial, gas, electric, sewage, transportation, emergency medical care, and water. Without these "lifelines", our communities suffer greatly. Protecting them is critical (*Grand Challenges*, 9). As was noted earlier, the definition of critical services under DMA 2000 does not include transportation. However, without roads, bridges, airports, pack animals (e.g. horses, camels), automobiles, planes, trains, and boats, it will be difficult to evacuate people from impacted areas and difficult to provide aid to the impacted areas as needed. Both the CERG and the City of Portland risk management frameworks include transportation as critical facilities.

Two challenges are noted for Grand Challenge #4: 1) develop science and technology to prevent cascading failures in public infrastructure systems and 2) enhance the ability to protect public health before and after a hazard event. To achieve the first challenge, the tools and models must be developed to understand the interrelationship of infrastructure that is required to protect public infrastructure. If the infrastructure remains in place, the continuity of services occurs and this also prevents a cascading serious of failures. Risk assessment tools are also needed to determine the impacts to infrastructure. For the second challenge, there must be an increased understanding of hazard events and their impact on health (*Grand Challenges*, 9).

The key research requirements include, for example, developing innovative assessment tools for emergency response procedures. Major technology investment should include the identification and deployment of cost-effective technologies that ensure the survivability of critical utilities and other infrastructures (*Grand Challenges*, 9). Grand Challenge #4 is most related to the CERG risk management framework component, to identify the vulnerability. Once the vulnerability is identified, then the risk assessment, another CERG risk management framework component, can occur.

Grand Challenge #5: *Assess Disaster Resilience Using Standard Methods. The Federal government is working with local governments, universities, and private organizations to establish standards to assess disaster resilience.* Communities can use the standards to measure and re-evaluate how they are progressing in their efforts to become more disaster resilient. It will help communities keep clear and present goals, and the paths to achieve the goals, in the effort to become more disaster resilient. Changes can be made as needed for the communities (*Grand Challenges*, 10).

There are three challenges for Grand Challenge #5: 1) support intelligent community planning and investment strategies and protect natural resources with comprehensive risk assessments; 2) assess the resilience of the natural and human environment; and 3) learn from each hazard event. For the first challenge, the risk assessments should be made and used in collaboration with land use and investment information to make wise decisions that protect the community and the natural environment. For second challenge, the assessments must include examination of the natural and technological hazards. For the third challenge, the hazard events should be analyzed and the results made public to support hazard research and mitigation plans (*Grand Challenges*, 10).

The key research requirements include, for example, establishing methods and standards for the evaluation of resilience to hazards. The evaluation should include the economic, ecological, and technological consequences of disasters. The major technological investments include, for example, developing comprehensive pre-event recovery plans (*Grand Challenges*, 10). The CERG risk management framework component most related to Grand Challenge #5 is risk assessment.

Grand Challenge #6: *Promote Risk-Wise Behavior*. Hazard information must be conveyed to the community in a manner that creates trust and understanding. The community must then respond to that hazard information. Without that communication connection, the community will not respond fully to the hazards. The U.S. must understand human behavior, cultural norms, economy, and other elements that work together to form our reactions to information people receive (*Grand Challenges*, 11). Social science skills are essential to understand the social, environmental, political, and economic conditions of a community.

For Grand Challenge #6 there are three challenges: 1) raise public awareness of local hazards; 2) warn people with consistent, accessible, and actionable messages and a national all-hazards emergency communication systems; and 3) develop policies that promote risk-wise behavior and are based in social science research. For the first challenge, reliable and integrated data must be available. For the second challenge, comprehensive emergency communication systems are needed to warn people and to specify actions to be taken in the event of a hazard. For the third challenge, research is needed to better understand why people might expose themselves to hazards and what would motivate people to avoid hazards or take mitigating actions before and during a disaster (*Grand Challenges*, 11).

Key research requirements include, for example, developing an enhanced understanding of effective techniques for educating the public and gaining community support for preparedness and disaster prevention activities. For major technology investments, for example, it is important to assemble and coordinate an integrated emergency communication systems among response organizations at the local, state, and Federal levels (*Grand Challenges*, 11).

Grand Challenge #6 relates to the earlier discussion about communicating about science and policy in risk management. This Grand Challenge most closely relates to the CERG risk management framework component of risk management, or prevention and preparedness.

In the United States, the categories of disasters, as used in the *Grand Challenges* document, include: severe weather, volcanoes, wildland fire, technological, drought, earthquakes, floods, public health/environmental disaster. The *Grand Challenges* document provides a list of "Research Requirements and Technology Investments by Hazard" for each of the six Grand Challenges. What follows is a brief description of the categories of disasters in the United States. Where relevant, some comments regarding disasters in the City of Portland are provided.

Wildland Fire: Tens of millions of wildland acres burn in the wilderness and thousands of wildland fires occur at the wildland/urban interface – where the urban and rural areas meet. The fire season of 2000 included the largest areas of wildfire that burned in the United States since the 1960s. From 1999 to 2002, the average area burned by wildfires was 6.1 million acres (24,685.82 km sq.) with an estimated cost of $1.1 billion for wildland fire suppression (*Grand Challenges*, 4).

Wildfires are most common in the eastern and southern portions of the State of Oregon (NHMP, WF-2). However, the City of Portland is at risk from wildfires (NHMP, WF-2). In the wildland-urban interface, where the urban areas meet with the rural areas, homes and other structures are frequently constructed within the densely forested landscape. The City of Portland covers 87,040 acres which includes 14,500 acres of natural areas (NHMP, WF-3). The natural areas are identified as areas with a high fire risk by the Portland Fire and Rescue Wildfire Risk-Mapping Program because both residential and commercial development can be found surrounding these natural areas (NHMP, WF-3).

According to the NHMP, certain conditions must exist for wildland interface fires to occur. This makes wildland fire different than most natural hazards because the hazard is not designated by geography alone (NHMP, WF-5). The Wildland Hazard Assessment for the City of Portland found that 27,100 households are at risk for wildland fire. Of these households, 7,500 of the people are over the age of 65 and 8,700 people have an income of less than $20,000 a year (NHMP, WF-9).

Volcanoes: There are nearly 70 active or potentially active volcanoes. Thousands of acres of land have been impacted, with substantial economic and societal disruption, from volcanic eruptions in Hawaii, Oregon, Washington, California, and Alaska in the 20th century (*Grand Challenges*, 4).

Technological hazards: Release of hazardous substances like chemicals, toxic substances, gasoline, oil, nuclear material, radiological material, flammable material, explosive material (gas, liquid, solids), that affect human health and safety, the environment, and the local economy (*Grand Challenges*, 4).

Severe weather: Severe weather, including severe storms (for example, snow, ice, rain), tornadoes, hurricanes, and heat waves, has become a major source of challenging situations, particularly with the change in population demographics. Examples of extreme severe weather events include the 534 tornadoes that occurred in May 2003 (the previous record was 399 in 1992) and the heat wave in Chicago that killed 739 people in 1995 (*Grand Challenges*, 4).

In the Portland area, severe storms include rain, snow, ice, freezing rain, cold temperatures, and high winds. High winds and freezing rain can affect power lines by potentially interrupting service. Disruption of service can severely impact the public utilities, telecommunications, and transportation routes (NHMP, SW-2).

Drought: Affecting more people than any other natural hazard, drought is a widespread problem in the United States. The annual estimated losses due to drought range from $6 to $8 billion. Increasing population in dry areas of the country, growing urbanization of the country, and changes in water and land use, have provided a greater magnitude in complexity of interaction with drought (*Grand Challenges*, 3).

Earthquakes: In the United States, 75 million persons in 39 states face significant risk from earthquakes. On average, seven earthquakes per year have a magnitude of 6 or greater, while thousands of smaller earthquakes happen each year (*Grand Challenges*, 3).

Oregon is ranked as the third highest state in the nation in terms of potential damage from earthquakes. Previously, Oregon as not considered an area of high seismicity. Buildings and infrastructure were not constructed to withstand the now anticipated earthquake magnitudes. However, recent studies have concluded that Oregon has a history of seismic events. In addition, the Cascadia Subduction Zone, which runs through Oregon, is capable of producing a 9.0 magnitude earthquake. Within Portland, geologists have found evidence that the Portland Hills Fault is still able to generate earthquakes. Geologists suspect there are other faults within the Portland city limits. Estimates of damage within the city limits show approximately $59 billion in commercial and residential assets are at risk (NHMP, EQ-2). Approximately 39% of the respondents to a survey done in 1999 by the Oregon Department of Geology and Mineral Industries think that an earthquake will occur in Oregon in the next 10 years (NHMP, EQ-11). The survey reveals a perception of risk that should be used as part of the risk management activities in the State of Oregon.

The NHMP makes the distinction that chronic hazards "occur with some regularity and may be predicted through historic evidence and scientific methods." Chronic hazards are different from catastrophic hazards, "Catastrophic hazards do not occur with the frequency of chronic hazards, but can have devastating impacts of life, property, and the environment." Earthquakes are classified as a catastrophic hazard while floods, landslides, extreme weather, and wildfire are classified as chronic hazards (NHMP, 1-9).

Floods: The most frequent disaster in the United States is floods. In fact, one in three Federal disaster declarations are related to flooding. Approximately $2 billion a year in property damages occurs each year. The increase in population in flood prone areas, in conjunction with an increase in heavy rainfall in the last fifty years, has increased the economic losses related to floods (*Grand Challenges*, 3).

Portland is located at the confluence of the Columbia River and the Willamette River. These major rivers have many tributaries. Rivers provide many benefits, but they have also provided many flood related challenges. Portland has a long history of flooding and losses due to floods. The floods of 1964 and 1996 are legendary. The floods of 1964 totaled over $157 million dollars of damage and 20 lives lost (NHMP, FL-2). Over $220 million dollars from several Federal relief programs was given to Oregon for the three flood and landslide disasters that occurred in 1996 and 1997 (NHMP, Appendix C, 4).

The *Grand Challenges* document does not list landslides as a hazard; however, landslides are an identified hazard in the City of Portland. Nationally, landslides cause 25-50 deaths each year, and cost approximately $1-2 billion a year in damages. In the City of Portland, landslides do not always damage private property but they often damage transportation routes, fuel and energy conduits, and communication facilities (NHMP, LS-2). Landslides in the Portland area can be slow moving and rapidly moving landslides. Rapidly moving landslides prevent a greater risk than slow moving landslides. Slow moving landslides often cause property damage but are unlikely to result in serious human injuries. In Oregon, a rapidly moving landslide killed five people in 1996 (NHMP, LS-2). This event was the impetus for the creation, by the Oregon governor, of a landslide task force and also resulted in changes in state laws.

Public health and environmental disasters: These disasters may be a primary result of a previously existing hazard such as the release of hazardous materials or from natural events (*Grand Challenges*, 3).

Conclusions

"Indeed, land use planning, hazard mitigation, and sustainable communities are concepts with a shared vision in which people and property are kept out of the way of hazards, the mitigative qualities of the natural environment are maintained, and development is resilient in the face of natural forces" (Mileti, 7).

The title of this paper asks, is the City of Portland's Natural Hazard Mitigation Plan idealistic or realistic? Additional questions raised include, does the NHMP fit within the CERG risk management framework? Will the City be adequately prepared with the NHMP or should additional steps be taken?

Both the CERG risk management framework and the City's NHMP goals are focused on reducing risk and having sustainable communities. The NHMP fits within the CERG risk management framework. Both frameworks use the essential four components of 1) identifying the hazard; 2) identifying the vulnerability; 3) performing a risk assessment and identifying the management of the hazard; and 4) identifying how to prevent and prepare for disasters. The City of Portland, in the NHMP, specifically identified the local hazards and identified a level of severity for each. Existing, mapped, hazard information was used and the need for additional mapped information was identified. The hazards were identified in terms of vulnerability, and a risk assessment was prepared. Prevention and preparedness actions were identified. The City made a matrix of action items during preparation of the NHMP; it will be used to implement the risk management framework.

Of note when comparing the CERG and City of Portland risk management frameworks is that both include transportation as critical facilities and both have very little focus on rehabilitation and recovery. The CERG risk management framework is voluntary and has a goal of being applicable to any global situation. The City's NHMP is a voluntary plan, although it was created as required to meet a Federal regulation (DMA 2000).

With the preparation of and implementation of the NHMP, the City's existing risk management framework changed. The preparation of the NHMP forced the City to focus on what work had been done already in the risk management framework. The creation of the Portland Office of Emergency Management and the preparation of the NHMP bring a new level of attention to the City's ability to be prepared for natural disasters. The NHMP established a monitoring and maintenance system – the City has a responsibility to monitor what elements of the NHMP are implemented. There is a committee working with POEM and other bureaus to implement the NHMP, as previously described. There is a Federal mandate to review the NHMP every five years. These monitoring requirements, review requirements, and committee oversight are all tools to require implementation of a risk management framework.

The City's acceptable risk level is moderate on a scale of low, moderate, and high levels of acceptable risk. The City has, as described, many local, state, and Federal requirements to meet regarding risk management. The City's political will has increased over the last several years with a focus on recognition of the natural hazards that affect the citizens and a focus to prepare its citizens. The City's will is constantly tested because development and growth pressures on the City are quite strong. This is one of the main difficulties in fully implementing the risk management framework and the NHMP.

The ideal is a goal and a vision. The reality is the fact. The NHMP is a plan with vision that is rooted in reality. Extensive research was done to prepare the NHMP. As with most plans, the key component is people. Without people dedicated to implementing the NHMP and without support for the implementation of the NHMP (both monetarily and politically) the NHMP will be just another plan. There is an increasing awareness of disasters. There is an increasing realization that disasters can and will happen anywhere. Having rules in place is functional only when they are implemented. Communication and collaboration are critical to the success of prevention, mitigation and recovery. With this focus on risk management by the City, I believe there is a social and political momentum in Portland that will be maintained and provide a forum to implement the NHMP.

One of the keys is to implementing the NHMP is land use planning; this concept works, as noted above, effectively in conjunction in ideal and in reality with the concepts of mitigation and sustainable communities. The social, political, economic, and environmental aspects of a society are included. There is a great basis of land use planning Portland, an emphasis on sustainable communities, and a new focus on mitigation. Therefore, there is a strong foundation established for the success of the NHMP, and I believe the NHMP will be successful as a realistic plan.

In times of economic challenges, which every jurisdiction in the U.S. and the world face, it is difficult to make choices. These choices may potentially mean giving up time and money now, but they are risk management choices that make a community more disaster resistant and they are choices that will make our global community a safer place.

References Cited and Consulted

Babayev, G., Cheiklounis, G., Defago, M. and Sears, T.R. (2005). *Fieldwork on Risk Assessment and Its Management in a Volcanic Context: The Aeolian Island Vulcano (Italy).*

Benson, C., and Twigg, J. Provention Consortium. (2004). *Measuring Mitigation: Methodologies for Assessing Natural Hazard Risks and the Net Benefits of Mitigation: A Scoping Study*. 149 pages.

Committee on Environment and Natural Resources, National Science and Technology Council (2005). *Grand Challenges for Disaster Reduction. A Report of the Subcommittee on Disaster Reduction*. 21 pages.

Farrell, A., Zerriffi, H., and Dowlatabadi, H. (2004). Energy Infrastructure and Security. *Annual Review of Environment and Resources.* Volume 29. 42 pages.

Foster, K., Vecchia, P., and Repacholi, M. (2000). *Risk Management: Science and the Precautionary Principle.* Science. Volume 288. 7 pages.

Lagomarsino, B. (2004). *Planning Under the Disaster Mitigation Act*. Presentation at the American Planning Association National Conference.

LeDuc, Andre (2006). State Coordinator, Partners for Disaster Resistance and Resilience. Director, Oregon Natural Hazards Workgroup. Personal Communication.

(2004). *Mapping Vulnerability: Disasters, Development & People*. Eds. Greg Bankoff, Georg Frerks, and Dorothea Hilhorst. 236 pages.

Mileti, Dennis S. *Disasters by Design: A Reassessment of Natural Hazards in the United States*. 351 pages.

Natural Hazards Center (2006). Mitigation Generates Savings of Four to One and Enhances Community Resilience: MMC Releases Study on Savings from Mitigation. *Natural Hazards Observer*. Volume XXX Number 4. 3 pages.

Oregon Natural Hazards Workgroup (2002). *Partners for Disaster Resistance: Oregon Showcase State Strategic Plan 2002, Section 6: Communication and Coordination*. 10 pages.

Oregon Natural Hazards Workgroup (2005-2006). www.OregonShowcase.org.

Partners for Disaster Resistance (undated). *Oregon Showcase State: Disaster Resistant by Design*. Brochure.

Portland Office of Emergency Management (2006). www.portlandonline.com/oem.

Portland Office of Emergency Management et al (2005). *City of Portland Natural Hazard Mitigation Plan*. 1st Edition.

Platt, R. (1999). *Disasters and Democracy: The Politics of Extreme Natural Events*. 320 pages.

Rachel's Environment and Health News (1998). The Wingspread Statement on the Precautionary Principle. Number 586. 6 pages.

Romerio, F. (2005). *Economic Aspects of Risk Analysis and Management*. Presentation at the University of Geneva, Centre d'Etude des Risques Geologique.

Rueter, Patty (2006). Mitigation and Planning Coordinator, City of Portland's Office of Emergency Management. Personal Communication.

Sears, T. R. (2003). *The Sometimes Discordant Fusion of Science and Policy: An Example of a Land Use Planning Study of a Hazard Area in Dodson and Warrendale, Oregon*. 137 pages.

Sonnleitner, M. (2005). *Natural Disasters and Reinsurance*. Presentation at the University of Geneva, Centre d'Etude des Risques Geologique.

(2005). State of Oregon Land Use Planning Information. www.lcd.state.or.us/goalhtml/goals.html.

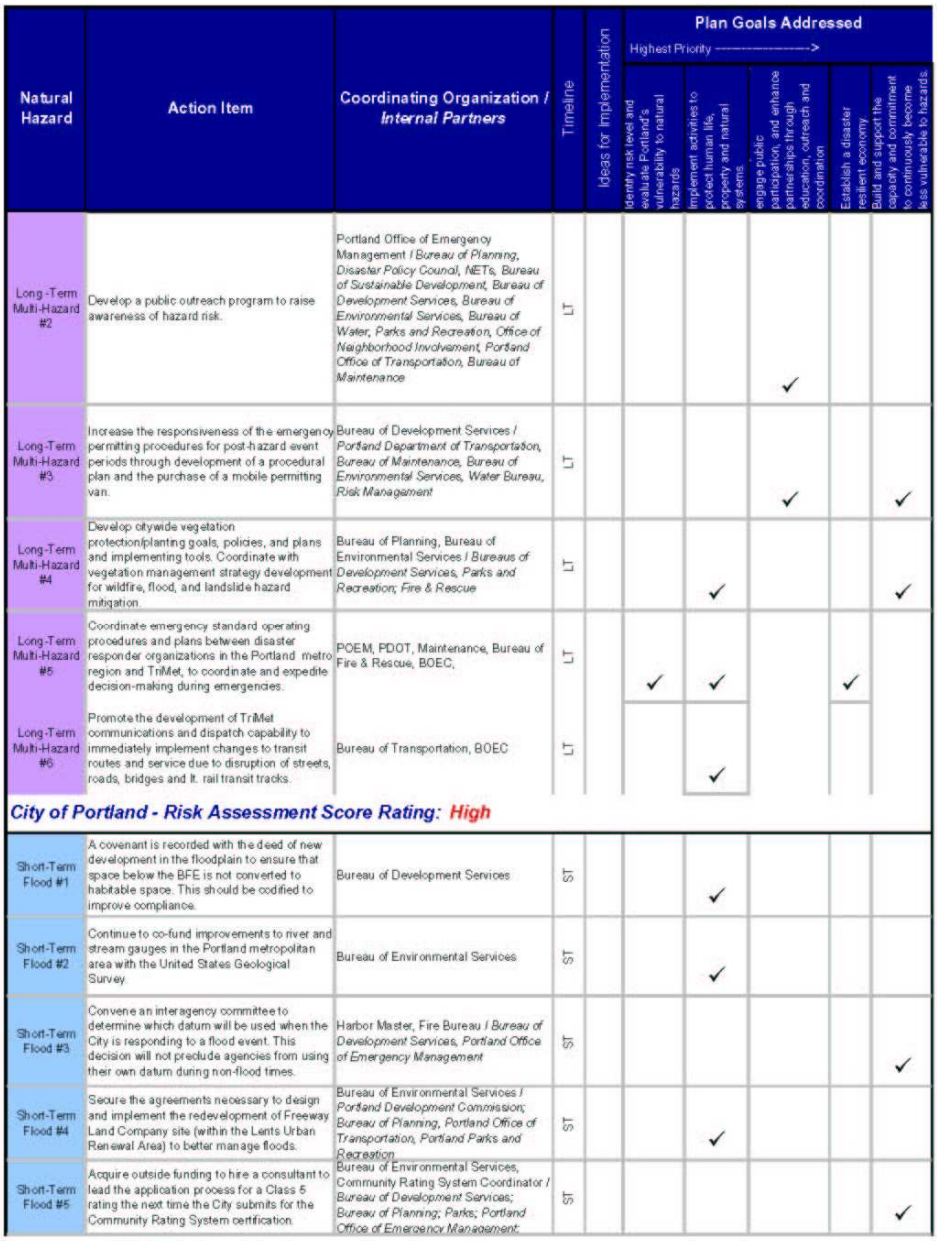
U. S. Congress (2000). *Disaster Mitigation Act of 2000 (DMA*), *Public Law 106-390*. 114 Stat. 1552 – 1576.

U.S. Congress (2006). *The Robert T. Stafford Disaster Relief and Emergency Assistance Act, as Amended by Public Law 106-390, October 30, 2000*. www.fema.gov/library/stafact.shtm#1.

(1981). *Webster's New Collegiate Dictionary*. 1532 pages.

Appendix A: City of Portland Natural Hazard Mitigation Plan Action Items – Organized by Hazard

Natural Hazard	Action Item	Coordinating Organization / *Internal Partners*	Timeline	Ideas for Implementation	Plan Goals Addressed (Highest Priority ——————>) Identify risk level and evaluate Portland's vulnerability to natural hazards	Implement activities to protect human life, property and natural systems.	engage public participation, and enhance partnerships through education, outreach and coordination	Establish a disaster resilient economy	Build and support the capacity and commitment to continuously become less vulnerable to hazards.
City of Portland Natural Hazard Mitigation Plan Action Items - Organized by Hazard									
Multi-Hazard Mitigation Action Items									
Short-Term Multi-Hazard #1	Continue to involve the public in updating the Natural Hazard Mitigation Plan.	Portland Office of Emergency Management, Bureau of Planning, Office of Neighborhoods	ST				✓		✓
Short-Term Multi-Hazard #2	Form a committee to identify and coordinate critical transportation (street and highway) networks.	Portland Department of Transportation, Bureau of Maintenance / *Bureaus of Planning, Fire & Rescue, Police, Parks and Recreation, Urban Forestry*	ST		✓		✓		✓
Short-Term Multi-Hazard #3	Revise Portland's Comprehensive Plan to address natural hazards including, but not limited to, floods, landslides, earthquakes, wildland fires, and winter storms.	Bureau of Planning / *Portland Office of Emergency Management*	ST		✓	✓			✓
Short-Term Multi-Hazard #4	Incorporate assessment of terrorist threats into Portland's Hazard Mitigation Plan. Additionally, consider natural hazards if future opportunities to address terrorist threats to Portland arise.	Portland Office of Emergency Management / *Bureaus of Fire & Rescue, Police, and Transportation*	ST		✓			✓	✓
Short-Term Multi-Hazard #5	Acquire Light Detection and Ranging (LIDAR) images of the Portland Metro area and the Bull Run Watershed.	Portland Office of Emergency Management / *Corporate GIS, Bureau Environmental Services, Fire and Rescue, Bureau of Water, Portland Office of Transportation*	ST		✓				✓
Short-Term Multi-Hazard #6	Use findings from Portland's Risk Assessment (HAZUS-MH) to enhance the existing debris removal plan.	Bureau of Sustainable Development / *Portland Office of Emergency Management, Portland Office of Transportation, Maintenance, Bureau of Environmental Services*	ST		✓	✓			
Short-Term Multi-Hazard #7	Create a mitigation mapping committee.	Portland Office of Emergency Management, Corporate GIS / *Bureau of Environmental Services, Portland Department of Transportation, Bureau of Development Services, Fire Bureau, Water Bureau, Bureau of Planning*	ST		✓				✓
Short-Term Multi-Hazard #8	Partner with utilities as they ensure continuity of service to the City of Portland.	Portland Office of Emergency Management / *Disaster Policy Council, Mitigation Sub-Committee leaders; Cable and Franchise*	ST					✓	
Short-Term Multi-Hazard #9	Develop a city employee emergency response plan to assure that city employees know what is expected of them so that services are continued.	Portland Office of Emergency Management / *Disaster Policy Council; Human Resources, OMF, Bureau of General Services, Fire and Rescue, Police, Emergency Communications*	ST				✓		
Long-Term Multi-Hazard #1	Revise Portland's Comprehensive Plan to address natural hazards including, but not limited to, floods, landslides, earthquakes, wildland fires, and winter storms.	Bureau of Planning / *Portland Office of Emergency Management*	LT		✓	✓			✓



Natural Hazard	Action Item	Coordinating Organization / *Internal Partners*	Timeline	Ideas for Implementation	Plan Goals Addressed (Highest Priority ——————>)				
					Identify risk level and evaluate Portland's vulnerability to natural hazards	Implement activities to protect human life, property and natural systems.	engage public participation, and enhance partnerships through education, outreach and coordination	Establish a disaster resilient economy	Build and support the capacity and commitment to continuously become less vulnerable to hazards.
Long-Term Multi-Hazard #2	Develop a public outreach program to raise awareness of hazard risk.	Portland Office of Emergency Management / *Bureau of Planning, Disaster Policy Council, NETs, Bureau of Sustainable Development, Bureau of Development Services, Bureau of Environmental Services, Bureau of Water, Parks and Recreation, Office of Neighborhood Involvement, Portland Office of Transportation, Bureau of Maintenance*	LT				✓		
Long-Term Multi-Hazard #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.	Bureau of Development Services / *Portland Department of Transportation, Bureau of Maintenance, Bureau of Environmental Services, Water Bureau, Risk Management*	LT				✓		✓
Long-Term Multi-Hazard #4	Develop citywide vegetation protection/planting goals, policies, and plans and implementing tools. Coordinate with vegetation management strategy development for wildfire, flood, and landslide hazard mitigation.	Bureau of Planning, Bureau of Environmental Services / *Bureaus of Development Services, Parks and Recreation; Fire & Rescue*	LT			✓			✓
Long-Term Multi-Hazard #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, PDOT, Maintenance, Bureau of Fire & Rescue, BOEC,	LT		✓	✓		✓	
Long-Term Multi-Hazard #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.	Bureau of Transportation, BOEC	LT			✓			
City of Portland - Risk Assessment Score Rating: High									
Short-Term Flood #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.	Bureau of Development Services	ST			✓			
Short-Term Flood #2	Continue to co-fund improvements to river and stream gauges in the Portland metropolitan area with the United States Geological Survey.	Bureau of Environmental Services	ST			✓			
Short-Term Flood #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.	Harbor Master, Fire Bureau / *Bureau of Development Services, Portland Office of Emergency Management*	ST						✓
Short-Term Flood #4	Secure the agreements necessary to design and implement the redevelopment of Freeway Land Company site (within the Lents Urban Renewal Area) to better manage floods.	Bureau of Environmental Services / *Portland Development Commission; Bureau of Planning, Portland Office of Transportation, Portland Parks and Recreation*	ST			✓			
Short-Term Flood #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.	Bureau of Environmental Services, Community Rating System Coordinator / *Bureau of Development Services; Bureau of Planning; Parks; Portland Office of Emergency Management;*	ST						✓

Natural Hazard	Action Item	Coordinating Organization / *Internal Partners*	Timeline	Ideas for Implementation	Plan Goals Addressed (Highest Priority ——————>)				
					Identify risk level and evaluate Portland's vulnerability to natural hazards	Implement activities to protect human life, property and natural systems.	engage public participation, and enhance partnerships through education, outreach and coordination	Establish a disaster resilient economy	Build and support the capacity and commitment to continuously become less vulnerable to hazards.
Short-Term Flood #6	Support MCDD in the continued calibration and updating of hydraulic models for conveyance and internal flood impacts to the four managed floodplains managed by Multnomah County Drainage District # 1.	Portland Office of Emergency Management, Bureau of Environmental Services / *Bureau of Planning*	ST		✓				
Short-Term Flood #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.	Mitigation Program Coordinator, Portland Office of Emergency Management / *Portland Office of Transportation*	ST						✓
Short-Term Flood #8	Secure funding to implement the passive flood management projects that are recommended in the Johnson Creek Restoration Plan. Coordinate with Portland Development Commission's urban renewal efforts in Lents and with other partners in other parts of the	Bureau of Environmental Services, Johnson Creek Watershed Manager / *Portland Development Commission, Parks and Recreation*	ST						✓
Short-Term Flood #9	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.	Johnson Creek Watershed Manager, Bureau of Environmental Services / *Parks and Recreation, Portland Development Commission*	ST			✓			
Short-Term Flood #10	Improve definitions and refine standards for stormwater retention in the Stormwater Management Manual (SWMM).	Development Services Division, Bureau of Environmental Services / *Bureau of Development Services, Bureau of Planning*	ST						✓
Short-Term Flood #11	Support development of a multiple-agency plan for Marine Drive closure coordination.	Portland Office of Emergency Management Mitigation Program Coordinator / *Bureau of Water, Portland Office of Transportation*	ST			✓			
Short-Term Flood #12	Provide staff to participate in Flood Fight Trainings lead by the Multnomah County Drainage District.	Portland Office of Emergency Management, Mitigation Program Coordinator / *Bureau of Maintenance, Police, Water Bureau*	ST				✓		✓
Short-Term Flood #13	Install a river gauge in the vicinity of the bridge over Johnson Creek at 108th. The gauge should be able to send data to a remote monitoring site.	Bureau of Maintenance, Environmental Systems Division Manager / *Bureau of Environmental Services; Portland Office of Transportation*	ST			✓			
Short-Term Flood #14	Install one-way valves on the outlet pipes of the storm inlets on SE Foster Road between 101st and 112th.	Environmental Systems Division Manager, Bureau of Maintenance / *Bureau of Environmental Services*	ST			✓			
Long-Term Flood #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.	Watershed Managers, Bureau of Environmental Services / *Department of Parks and Recreation, Bureau of Planning, Water Bureau*	LT						✓
Long-Term Flood #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.	Chief Fire Marshal / *Harbor Master, Fire Bureau, Portland Office of Emergency Management, Bureau of Development Services*	LT			✓			
Long-Term Flood #3	Develop a plan for addressing flooding in the Holgate Lake area.	Bureau of Environmental Services / *Bureau of Development Services, Parks and Recreation, Bureau of Planning*	LT						✓
Long-Term Flood #4	Improve hydraulic bottleneck that prevents discharge of chlorinated effluent to the Willamette River during high river levels.	Operating Manager Tryon Creek Wastewater Treatment Plant, Bureau of Environmental Services	LT			✓			
Long-Term Flood #5	As Waterfront Park remodeling is designed, ensure that Portland's downtown property and critical facilities remain protected from floodwaters.	Parks and Recreation / *Harbor Master, Fire Bureau, Bureau of Planning, Bureau of Development Services*	LT			✓			

Natural Hazard	Action Item	Coordinating Organization / *Internal Partners*	Timeline	Ideas for Implementation	Plan Goals Addressed (Highest Priority ——————>)				
					Identify risk level and evaluate Portland's vulnerability to natural hazards	Implement activities to protect human life, property and natural systems.	engage public participation, and enhance partnerships through education, outreach and coordination	Establish a disaster resilient economy	Build and support the capacity and commitment to continuously become less vulnerable to hazards.
Long-Term Flood #6	Support Multnomah County Drainage District (MCDD) as they develop a multiple-agency plan for initiation of traffic closure on the Columbia River as advised by MCDD and the Army Corps of Engineers.	Mitigation Program Coordinator, Portland Office of Emergency Management / *Portland Office of Transportation*	LT						✓
Long-Term Flood #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 mitigation of peak flows in Portland or result in significant reduction of flood damages.	Bureau of Environmental Services Systems Analysis Group	LT		✓				
Long-Term Flood #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, Bureau of Environmental Services / *Bureau of Development Services, Portland Office of Transportation*	LT			✓			
Long-Term Flood #9	Upgrade trestles that carry the main conduits of the water delivery system.	Water Bureau	LT			✓		✓	
Long-Term Flood #10	Create redundancy in the water delivery system at the three Sandy River crossings by burying conduits under the river.	Water Bureau, Operations and Support Manager	LT			✓			
Long-Term Flood #11	Provide funding for and participate in the development of a flood inundation model for the managed floodplains and downtown seawall.	Portland Office of Emergency Management Mitigation Program Coordinator / *COP, Bureau of Environmental Services, Water Bureau*	LT						✓
Earthquake Mitigation Action Items									
City of Portland - Risk Assessment Ranking High									
Short-Term Earthquake #1	Using television and print media, educate the public about the importance of signs containing bridge identification information during an earthquake.	Portland Office of Transportation	ST				✓		
Short-Term Earthquake #2	Assess existing earthquake related mitigation plans and vulnerability studies to identify areas of conflict, duplication, or gaps.	Portland Office of Emergency Management / *Fire Bureau, Office of Transportation, Bureau of Environmental Services, Water Bureau, Bureau of Development Services, Bureau of*	ST						✓
Short-Term Earthquake #3	Update the vulnerability analysis of Columbia Boulevard Wastewater Treatment Plant (CBWTP), Tyron Creek Wastewater Treatment Plant (TCWTP), and wastewater pump stations.	Bureau of Environmental Services	ST		✓				
Short-Term Earthquake #4	Prioritize the return of power to treatment plants (Tryon Creek and Columbia Boulevard) and pump stations.	Bureau of Environmental Services / *Portland Office of Emergency Management*	ST			✓			
Short-Term Earthquake #5	Lobby to implement legislation of General Obligation Bonds to fund rehabilitation of critical structures.	Governmental Relations / *Bureau of Development Services, Portland Development Commission, Portland Office of Emergency Management, Office of Transportation, Parks and Recreation*	ST						✓
Short-Term Earthquake #6	Address earthquake-generated landslide issues.	Portland Office of Emergency Management	ST			✓			
Short-Term Earthquake #7	Work with local jurisdictions to assess the capacity of landfills to accommodate earthquake debris; develop coordinated plans for disposal of debris in the aftermath of an earthquake.	Portland Office of Emergency Management / *Bureau of Maintenance, Office of Sustainable Development*	ST					✓	

Natural Hazard	Action Item	Coordinating Organization / *Internal Partners*	Timeline	Ideas for Implementation	Plan Goals Addressed (Highest Priority ——————>)				
					Identify risk level and evaluate Portland's vulnerability to natural hazards	Implement activities to protect human life, property and natural systems.	engage public participation, and enhance partnerships through education, outreach and coordination	Establish a disaster resilient economy	Build and support the capacity and commitment to continuously become less vulnerable to hazards.
Short-Term Earthquake #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 / *Bureau of Development Services, Bureau of Fire, Portland Office of Emergency Management*	ST			✓			
Short-Term Earthquake #9	Develop emergency evacuation plans for residential areas that are near significant hazardous materials storage facilities and heavy industrial areas.	Fire Bureau / *Portland Office of Emergency Management*	ST		✓	✓			
Short-Term Earthquake #10	Revise seismic design requirements for existing buildings.	Bureau of Development Services	ST		✓	✓	✓	✓	✓
Long-Term Earthquake #1	Evaluate funding alternatives that might accelerate seismic retrofitting of the City of Portland's bridges.	Portland Office of Transportation	LT			✓		✓	
Long-Term Earthquake #2	Conduct a vulnerability analysis of Portland's sewer system to identify elements with the potential for failure.	Bureau of Environmental Services / *Corporate Geographic Information Systems, Portland Department of Transportation, Fire Department, Police Department, Portland Office of Emergency Management, Bureau of Water*	LT		✓				
Long-Term Earthquake #3	Develop a plan to strengthen sewer infrastructure in areas where street overlays and sewers have potential to collapse in a seismic event.	Portland Office of Transportation / *Corporate GIS; Bureau of Maintenance, Bureau of Environmental Services, Bureau of Water, Portland Office of Emergency Management*	LT			✓			
Long-Term Earthquake #4	Develop a sewer failure response plan.	Environmental Services / *Corporate GIS, Maintenance, Environmental Services, Bureau of Water*	LT						✓
Long-Term Earthquake #5	Develop an educational program that targets homeowners, providing them with inexpensive methods that they can use to strengthen their homes against earthquake damage.	Portland Office of Emergency Management / *Bureau of Development Services, Bureau of Water, Fire Department*	LT			✓	✓		
Long-Term Earthquake #6	Assess the vulnerability of the water distribution system to seismic events; work toward hardening the system.	Bureau of Water	LT			✓			
Long-Term Earthquake #7	Partner with DOGAMI and USGS to obtain funding for completion of fault mapping and improved technology for the transfer of data and information.	Portland Office of Emergency Management	LT		✓				
Long-Term Earthquake #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.	Portland Office of Emergency Management / *Bureau of Development Services, Bureau of Planning, Portland Department of Transportation, Bureau of F...*	LT						✓
Long-Term Earthquake #9	Assess the stability of levees in the Columbia Corridor area, and develop appropriate emergency response plans to address potential levee failure and associated hazards.	Portland Office of Emergency Management / *Bureau of Water, Fire Bureau, Bureau of Environmental Services, Bureau of Maintenance*	LT			✓			✓
Landslide Mitigation Action Items									
City of Portland - Risk Assessment Rating ***Medium***									
Short-Term Landslide #1	Continue to maintain and improve internal City communications to facilitate coordination of landslide mitigation activities.	Bureau of Development Services / *Bureau Of Environmental Services, Portland Department Of Transportation, Bureau Of Maintenance, Bureau of Water, Parks and Recreation, Risk Management*	ST						✓

Natural Hazard	Action Item	Coordinating Organization / *Internal Partners*	Timeline	Ideas for Implementation	Plan Goals Addressed (Highest Priority ——————>)				
					Identify risk level and evaluate Portland's vulnerability to natural hazards	Implement activities to protect human life, property and natural systems.	engage public participation, and enhance partnerships through education, outreach and coordination	Establish a disaster resilient economy	Build and support the capacity and commitment to continuously become less vulnerable to hazards.
Short-Term Landslide #2	Improve property owner awareness of the importance of proper maintenance of private drainage systems.	Bureau of Environmental Services / *Bureau of Maintenance*	ST				✓		
Short-Term Landslide #3	Mitigate Portland's water supply infrastructure from landslide hazards.	Bureau of Water	ST			✓			
Short-Term Landslide #4	Initiate more operations and maintenance pilot projects along roads that inform the development of standards for managing stormwater in ditches in landslide prone areas.	Bureau of Environmental Services / *Bureau of Maintenance*	ST				✓		
Short-Term Landslide #5	Continue development of standards for small pump stations as an alternative to gravity sewers in inaccessible or high risk areas.	Bureau of Environmental Services / *Bureau of Development Services*	ST			✓			
Long-Term Landslide #1	Develop a comprehensive landslide map for the City of Portland to identify hazard areas and improve communication with the public.	*Bureau of Development Services / Planning Bureau, Water Bureau, Bureau of Environmental Services, Portland Department of Transportation, Bureau of Maintenance, Parks Operations and*	ST		✓		✓		
Long-Term Landslide #2	Acquire land or apply conservation easement for long term and permanent mitigation of risk.	*Bureau of General Services / Bureau of Planning, Parks and Recreation, Bureau of Development Services, Bureau of Environmental Services, Risk Management and*	ST			✓			
Long-Term Landslide #3	Complete a study of the West Hills drainage system that addresses the cumulative effects of development in the area.	*Bureau of Environmental Services, Planning and Modeling and Engineering Services / Bureau of Planning, Bureau of Development Services (Site Development)*	ST		✓				
Long-Term Landslide #4	Review the effectiveness of regulations related to development in identified landslide hazard areas.	Bureau of Development Services (Land Use Services and Site Development), Bureau of Planning, *Bureau of Environmental Services*	LT			✓			
Long-Term Landslide #5	Update the Bureau of Environmental Services Sewer and Drainage Facilities Design Manual.	Bureau of Environmental Services	LT			✓			
Long-Term Landslide #6	Employ alternate construction methods such as trenchless construction on City projects to reduce the impact that development can have in landslide prone areas.	Bureau of Environmental Services	LT			✓			
Wildfire Mitigation Action Items									
City of Portland - Risk Assessment Rating Medium									
Short-Term Wildfire #1	Consolidate unassigned and/or unmanaged vegetated areas owned by the City of Portland under a single land management umbrella.	Parks, Bureau of Environmental Services / *Water, Portland Office of Transportation, Bureau of General Services*	ST						✓
Short-Term Wildfire #2	Procure funding for management of vegetated natural areas with high wildfire danger, including public and private properties.	Fire, Portland Parks and Recreation, Bureau of Environmental Services / *Bureau of Planning, Portland Office of Transportation, Bureau of General Services*	ST						✓
Short-Term Wildfire #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, Bureau of Development Services,Corporate GIS / *BIT, Planning, Parks, Bureau of Environmental Services, Bureau of Water*	ST		✓				
Short-Term Wildfire #4	Provide wildfire management training for City staff.	Portland Fire and Rescue / *Parks and Recreation, Bureau of Environmental Services, Bureau of Water, Bureau of Maintenance*	ST						✓
Short-Term Wildfire #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 / *DS, Fire and Rescue, Parks and Recreation, Bureau of Environmental Services, Portland Office of Transportation*	ST						✓

Natural Hazard	Action Item	Coordinating Organization / *Internal Partners*	Timeline	Ideas for Implementation	Plan Goals Addressed (Highest Priority ——————>)				
					Identify risk level and evaluate Portland's vulnerability to natural hazards	Implement activities to protect human life, property and natural systems.	engage public participation, and enhance partnerships through education, outreach and coordination	Establish a disaster resilient economy	Build and support the capacity and commitment to continuously become less vulnerable to hazards.
Short-Term Wildfire #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 / *Bureau of Development Services, Fire and Rescue, Parks and Recreation, Bureau of Environmental Services, Portland Office of Transportation*	ST						✓
Short-Term Wildfire #7	Identify conditions of approval and mitigation strategies that could be applied to new development or redevelopment in high fire risk areas.	Bureau of Development Services / *Bureau of Planning, Fire and Rescue, Parks and Recreation, Bureau of Environmental Services, and Portland Office of Transportation*	ST			✓			
Short-Term Wildfire #8	Integrate wild land fire risk educational opportunities into existing City stewardship programs. Provide education for both internal and external partners.	Bureau of Environmental Services / *Fire and Rescue, Bureau of Water, Bureau of Planning, Bureau of Development Services, Parks and Recreation, Portland Office of Transportation, Portland Office of Emergency Management, Office of Neighborhood*	ST				✓		
Short-Term Wildfire #9	Improve the system for identifying new construction in areas subject to wildfires and communicating this information to the affected land owners.	Bureau of Development Services / *Fire and Rescue; Bureau of Water, Portland Office of Transportation, Office of Neighborhood Involvement, Bureau of Planning*	ST				✓		✓
Short-Term Wildfire #10	Conduct systematic reviews of Portland's large, publicly owned, wildland tracts regarding fire safety and ecological health to inform land management decisions.	Portland Parks and Recreation / *Bureau of Environmental Services, Fire and Rescue, Bureau of Water, Bureau of Planning, Portland Office of Transportation, Office of Neighborhood Involvement*	ST		✓				
Short-Term Wildfire #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*	ST				✓		
Short-Term Wildfire #12	Implement a neighborhood wildland interface disaster planning program.	Portland Office of Emergency Management, Neighborhood Emergency Team, Office of Neighborhood Involvement / *Fire and Rescue, Police*	ST				✓		
Short-Term Wildfire #13	Review and potentially refine City contract specifications for machinery operations during "Red Flag" weather conditions.	Fire and Rescue / *Bureau of Environmental Services, Portland Parks and Recreation, Water, Bureau of Maintenance*	ST			✓			
Short-Term Wildfire #14	Convene a standing wildland interface fire technical group.	Fire and Rescue / *Portland Parks and Recreation, Bureau of Environmental Services, Portland Office of Emergency Management, Bureau of Water, Portland Office of Transportation, Bureau of Development Services, Bureau of Planning*	ST						✓
Short-Term Wildfire #15	Index City wildfire mitigation plans and activities.	Fire and Rescue / *Portland Parks and Recreation, Bureau of Environmental Services, Portland Office of Emergency Management, Portland Office of Transportation, Metro, Bureau of Development Services, Bureau of Planning*	ST						✓
Short-Term Wildfire #16	Identify water grid engineering requirements for firefighting in wildfire areas.	Bureau of Fire, Bureau of Water	ST			✓			
Long-Term Wildfire #1	Improve public education and understanding about wildfire occurrence, risk, and prevention.	Portland Fire and Rescue / *Parks, Bureau of Environmental Service, Portland Office of Transportation, Bureau of Planning*	LT				✓		

Natural Hazard	Action Item	Coordinating Organization / *Internal Partners*	Timeline	Ideas for Implementation	Plan Goals Addressed (Highest Priority ——————>)				
					Identify risk level and evaluate Portland's vulnerability to natural hazards	Implement activities to protect human life, property and natural systems.	engage public participation, and enhance partnerships through education, outreach and coordination	Establish a disaster resilient economy	Build and support the capacity and commitment to continuously become less vulnerable to hazards.
Long-Term Wildfire #2	Review the feasibility of adopting portions of nationally recognized wildfire interface codes to strengthen building standards in wildfire risk areas.	Portland Fire & Rescue, Bureau of Development Services	LT			✓			
Long-Term Wildfire #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.	Bureau of Development Services, Fire and Rescue / *Bureau of Planning, Parks and Recreation, Bureau of Environmental Services, Portland Office of Transportation, and the Office of Neighborhood Involvement*	LT		✓				
Long-Term Wildfire #4	Complete an assessment to characterize high priority wildfire risk areas and recommend specific mitigation strategies.	Fire and Rescue / *Parks and Recreation, Bureau of Environmental Services, Bureau of Planning, Bureau of Development Services, Bureau of Water, Portland Office of Transportation*	LT		✓				
Long-Term Wildfire #6	Explore avenues for funding interface home construction upgrades to low income homeowners.	Fire and Rescue / *Bureau of Development Services, Office of Neighborhood Involvement*	LT						✓