Natural Hazards

Introduction

Oregon's statewide planning goals and guidelines include Goal 7: Areas Subject to Natural Hazards. The purpose of this goal is to protect life and property from natural disasters and hazards. This goal is accomplished by identifying and inventorying the types of potential natural disasters and hazards that might affect the community. Inventory information is the basis of subsequent planning and implementation activities.

In May 2009, Polk County adopted a Multi-Jurisdictional Hazard Mitigation Plan Update. This plan includes appendices for each city in the County describing possible natural hazards, the risk to critical facilities, and planned mitigation actions. Hazard mitigation is work done to minimize the impacts of any type of hazard event before it occurs. Mitigation actions include public education and outreach, programs, projects, and policy actions intended to minimize damage from natural hazards.

The purpose of this section is to identify the types of natural hazards within the Monmouth urban area and describe the community's hazard mitigation activities. The descriptions of natural hazards, which could impact Monmouth and the associated mitigation actions considered, are taken from the Polk County Multi-Jurisdictional Hazard Mitigation Plan Update, which was adopted by the City of Monmouth in 2009.

Floods

A flood is the temporary inundation of water or mud on normally dry land. Heavy or prolonged rain, snowmelt, or dam collapse can cause inundation, as can riverine and flash floods. (NOAA 2008) Urban and riverine flooding primarily affect Polk County.

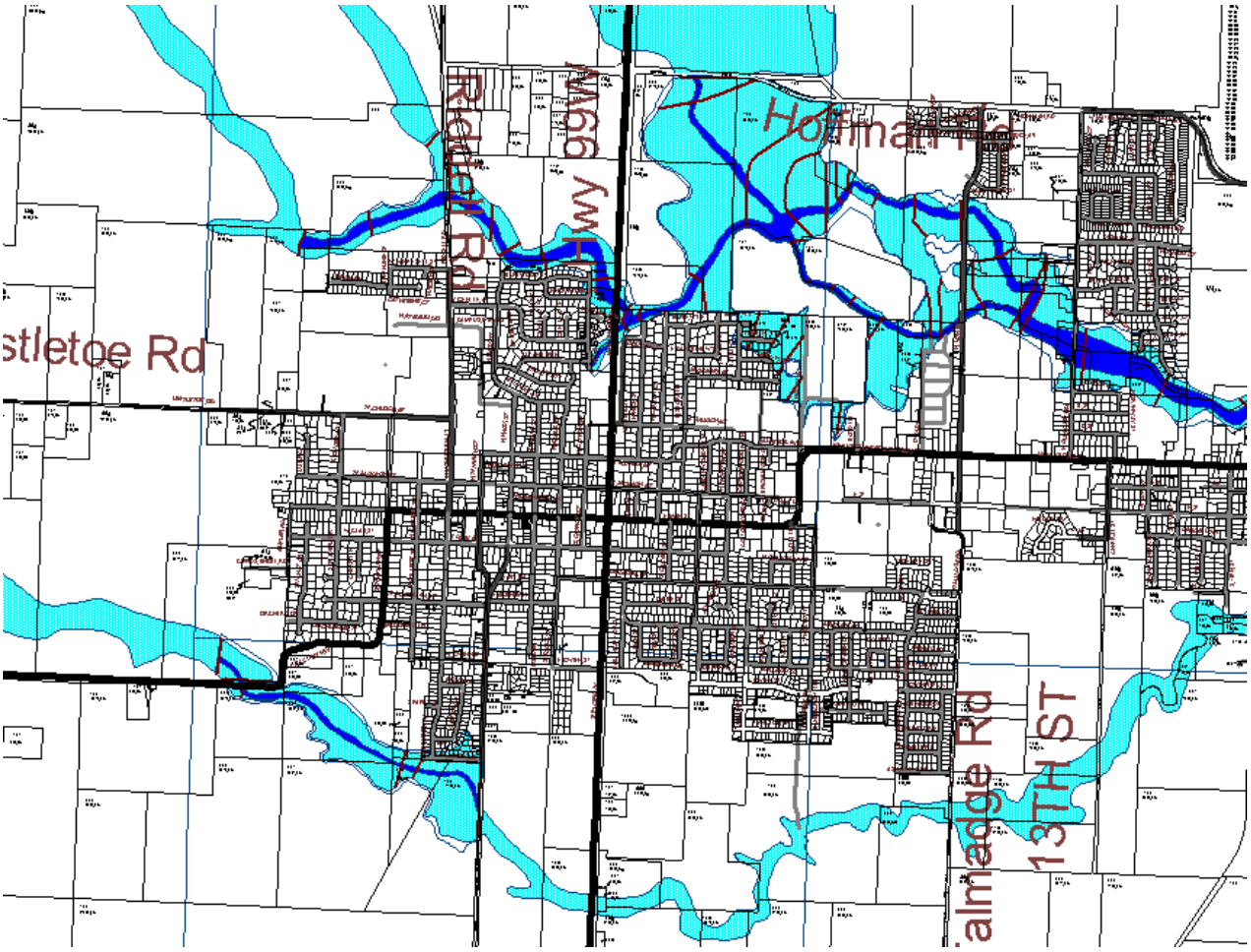
Urban flooding occurs in developed areas where the amount of water generated from rainfall and runoff exceeds the stormwater systems' capacity. As land is converted from agricultural and forest to urban uses, it often loses its ability to adsorb rainfall. Rain flows over impervious surfaces such as concrete and asphalt and into nearby storm sewers and streams. This runoff can result in the rapid rise of floodwaters. During urban floods, streets can become inundated, and basements can fill with water. Storm drains often back up because of the volume of water and become blocked by vegetative debris like yard waste, which can cause additional flooding. Development in the floodplain can raise the base flood elevation and cause floodwaters to expand past their historic floodplains. (FEMA 2008c)

Riverine or overbank flooding of rivers and streams is the most common type of flood hazard. Riverine flooding most frequently occurs in winter and late spring. Air rises and cools over the Coast Range and its foothills and heavy rainfall develops over high-elevation streams, as storms move from the Pacific across the Oregon Coast. In this region, as much as four to six inches of rain can fall over a 24-hour period. Severe and prolonged storms can raise rivers and streams to their flood stages for three to four days or longer. (State of Oregon 2008)

The Federal Emergency Management Agency (FEMA) has mapped most of the flood-prone streams in Oregon for 100- and 500-year flood events. A 100-year flood (one percent occurrence probability of occurring within any given year) is used as the standard for floodplain management in the United States and is referred to as a base flood. Flood Insurance Rate Maps (FIRMS) prepared by FEMA provide the most readily available source of information for 100-year floods. FEMA released a new Flood Insurance Rate Map (FIRM) for Monmouth on December 19, 2006.

Flooding in Monmouth is associated with Ash Creek. An area totaling approximately 73 acres within the Monmouth urban area are located within the 100-year floodplain of Ash Creek. The 100-year floodplain for Ash Creek as mapped by FEMA is shown in Figure 1.

Figure 1
Ash Creek 100-Year Floodplain



Winter Storms

Winter storms occurring in Polk County result in several natural hazards— including floods, landslides/debris flows, ice formations, snow, and wind. Each on its own, or in combination, can completely immobilize emergency response activities, close down transportation corridors, and disrupt transportation and utilities. Winter storms in Polk County can bring rain as well as snow, or can be followed by rising temperatures that melt newly fallen snow. Either scenario often causes flooding; most floods in western Oregon occur as a result of winter storms.

Ice and snow storms, which can include freezing rain, sleet, and hail, can be the most devastating of winter weather phenomena and are often the cause of automobile accidents, power outages and personal injury. Ice storms result in the accumulation of ice from freezing rain, which coats every surface, it falls on with a glaze of ice. Freezing rain is most commonly found in a narrow band on the cold side of a

warm front, where surface temperatures are at or just below freezing. Typically, ice crystals high in the atmosphere grow by collecting water vapor molecules, which are sometimes supplied by evaporating cloud droplets. As the ice crystals fall, the air warms and the particles melt and collapse into raindrops. As the raindrops approach the ground, they encounter a layer of cold air and cool to temperatures below freezing. However, since the cold layer is shallow, the drops themselves do not freeze, but rather are supercooled, that is cooled in a liquid state to below-freezing temperatures. These supercooled raindrops freeze on contact when they strike the ground or other cold surfaces.

Snowstorms happen when a mass of very cold air collides with a mass of warm air. The warm air rises quickly and the cold air cuts underneath it, cooling and condensing as it rises, forming a cloudbank in the process. As the moisture droplets in the cloud cool to a point below freezing, they become ice crystals, which then collide within the cloud and snow is formed. Similar to those of ice storms, the effects of a snowstorm can disturb a community for weeks or even months. The combination of heavy snowfall, high winds and cold temperatures poses danger from prolonged power outages, automobile accidents and transportation delays, dangerous walkways, and through direct damage to buildings, pipes, crops, other vegetation, and livestock. Buildings and trees can also collapse under the weight of heavy snow.

Drought

Drought is variously defined as a period of abnormally dry weather creating hydrologic imbalance, shortage of precipitation adversely affecting crops, or a period of below average water in streams and lakes, reservoirs, aquifers, and soils. (USGS 2008) There is no universal measure of precipitation or dryness that signifies drought. Historically, droughts have been seen as unpredictable and unavoidable events. Climate fluctuations occur everywhere, and periods of low precipitation are a normal, recurrent feature of climate.

Drought is commonly referenced in terms of its effects on agriculture, with crop damage or failure used to measure its effects. Other direct environmental effects of drought include livestock death or decreased production, wildland fire, impaired productivity of forest land, damage to fish habitat, loss of wetlands, and air quality effects. Indirect effects to society are measured by the economic and physical hardships brought on by drought and by the increased stress on residents of a drought-stricken area. (ONHW 2004)

El Niño/Southern Oscillation

El Niño/Southern Oscillation weather patterns portray periodic warming and cooling of the central Pacific Ocean. This warming and cooling cycle has global implications as normal weather patterns are altered over vast areas of the world, causing changes in temperature and precipitation from Chile to Indonesia to the Pacific Northwest.

During El Niño periods, alterations in atmospheric pressure in equatorial regions yield an increase in the surface temperature off the west coast of South America. This gradual warming sets off a chain reaction affecting major air and water currents throughout the Pacific Ocean. In the North Pacific, the Jet Stream is pushed north, carrying moisture laden air up and away from its normal landfall along the Pacific Northwest coast. In Oregon, this shift results in reduced precipitation and warmer temperatures, normally experienced several months after the initial onset of the El Niño. (Taylor 2008) These periods tend to last nine to twelve months, after which surface temperatures begin to trend back towards the long-term average.

La Niña periods ensue when surface temperatures increase past the long-term average. Typical weather patterns throughout the Pacific Ocean are strengthened, yielding stormier than normal weather throughout

the Pacific Northwest. Above average precipitation and colder temperatures are experienced across Oregon during these periods, with the potential for severe snow storms increasing. (Taylor 2008) These periods generally last longer than El Niño events, taking anywhere from one to three years to dissipate.

Both El Niño and La Niña periods tend to develop between March and June, and peak from December to April. (NOAA 2005)

Wildland Fire

Wildfires can be classified as wildland, wildland/urban interface, intermix, urban, and prescribed fires. Both wildland and wildland/urban interface fires are significant hazards due to the large amount of forested land in Polk County.

Wildland fires spread through the consumption of vegetation. They often begin unnoticed, spread quickly, and are usually signaled by dense smoke that may be visible for miles around. Wildland fires can be caused by human activities such as arson or campfires, or by natural events like lightning. Wildland fires often occur in forests or other areas with ample vegetation. When a wildland fire spreads to developed areas such as suburbs, small communities, or isolated homes, it becomes a wildland/urban interface fire.

In Oregon, wildland fire season normally begins in late June, peaks in August, and ends in October. However, a combination of above normal-temperatures and drought can increase the length of the traditional fire season. Over 70% are human caused, while 30% occur from lightning strikes. Wildland fire hazards in Polk County would be highest during prolonged drought periods, especially after periods of below normal rainfall, which would result in a combination of high fuel loads and unusually dry conditions.

The probability of a wildland fire occurring in the county is moderate according to historical fire patterns in Polk County with a one in 35-75 year recurrence interval. Although the county has not experienced many major fires like those that have affected other counties in Oregon, there is a significant possibility that a major wildland or wildland/urban interface fire could occur in the future.

Earthquakes

An earthquake is a sudden motion or trembling of the earth produced by the rupture of rock formations due to stresses beyond the rocks' elastic limits. The point inside the Earth where the rupture takes place is termed the hypocenter. The point on the planet's surface directly above the hypocenter is the epicenter. The effects of an earthquake can be felt far beyond the occurrence site. Earthquakes usually occur without warning and, after just a few seconds, can cause massive damage and extensive casualties. The most common effect of earthquakes is ground motion, or the vibration or shaking of the ground during an earthquake.

Monmouth is located within the geographical area bordering the Cascadia Subduction Zone. This zone is comprised of an 800-mile sloping fault and several smaller inland and offshore faults extending from British Columbia to the north and Northern California to the south. The fault system separates the Juan de Fuca and North American plates.

Hazard Shake Maps produced by the United States Geological Survey (USGS) consider two alternative scenarios for damaging earthquakes (M 8.3 or M 9.0) along the subduction zone. The shake maps show the ground motion level that has one (1) chance in 475 of being exceeded each year, which is equal to a

10 percent probability of being exceeded in 50 years. Polk County falls within the strong to very strong shaking range. All of Polk County is subject to earthquakes. However, the western portion of the county is more likely to be affected by a major quake, because of its closer proximity to the Cascadia Subduction Zone.

Wind

Wind is air flow that travels horizontally with respect to the Earth's surface and topography. High winds are defined as those that last longer than one hour at greater than 39 miles per hour (mph) or for any length of time at greater than 57 mph. Wind speeds vary with individual storms. Windstorms often accompany snow, ice, and extreme cold temperature events during winter storms. In general, the damaging effects of windstorms may extend for distances of 100 to 300 miles from the center of storm activity.

The Willamette Valley is somewhat sheltered from strong westerly winds, as the north-south orientation of the Coast Range and Cascades obstructs and slows these surface winds. However, winds blowing along a north to south axis (parallel to the major mountain ranges) can be destructive. Regardless of wind direction, these prolonged windstorms are likely to last an average of three to six hours before moving on.

High winds are likely to occur during the months of October through April. Destructive windstorms are less frequent, but recent research has revealed a connection between the neutral years of the El Niño Southern Oscillation conditions and major Pacific Northwest windstorms. Generally, windstorms have a short duration and winds move in a straight line with gust exceeding 50 mph. (ONHW 2006)

Erosion

Erosion is a process that involves the gradual wearing away, transport, and movement of land. However, not all erosion is gradual. It can occur quite quickly as the result of a flash flood, coastal storm, or other event. Most of the geomorphic change that occurs in a river system is in response to a peak flow event. It is a natural process but its effects can be exacerbated by human activity.

Generally erosion occurs when the flow of the river changes and is directed towards the banks or mid-channel islands. These changes can be caused by surface wind stress and gravity waves that occur during storm events (primarily severe winter storms), transporting sediment by bottom currents. (Sternberg 1986)

Erosion loss has historically occurred in Polk County. Rivers and creeks that have been identified to be subject to the effects of erosion include Ash Creek. The annual amounts of rain and wind that assail the shoreline combined with debris flows within the watersheds and loss of plant cover in riparian areas induce erosion, particularly during severe storm events.

Expansive Soils

The addition of moisture to any soil will cause a change in volume, which is referred to as a shrink-swell characteristic. (USDA NRCS 2008) Expansive soils are typically comprised of clay minerals that under some conditions are capable of increasing in volume when moisture is added.

In 1982, expansive soils were documented as the most costly natural hazard in the US, causing more damage than all other natural hazards combined, including earthquakes, floods, tornadoes, and hurricanes.

Soil expansion may be caused by changes in soil moisture, variations in thickness and composition of the expansive foundation soil, non-uniform structural loads, and the geometry of the structure. (US Army 1983) Potential sources of moisture changes are variation in precipitation, poor gutter or water drainage, vegetation changes over time (such as root growth of nearby trees), and plumbing leaks. By affecting the relative moisture of soils underlying foundations, uneven movement such as localized heave can occur, causing shifting and non-uniform foundation movements, thus impacting the structures above.

However, many sources of soil moisture change can be avoided, minimized, or mitigated through planning and structure maintenance. Some signs of possible soil expansion include separation of joints and trim; cracks in walls, floors, or concrete; and bowed or non-vertical walls. Some possible mitigation measures are maintaining separation between structures and runoff, using compact fill to shed water, not absorb it, and planting trees a distance equal to their mature height away from buildings to reduce root interference.

Potential damages to structures from expansive soils in Polk County include: cracks in grade beams, walls, and drilled shafts; distortion and cracking of pavements and on-grade floor slabs; failure of steel or concrete blocks supporting grade beams; jammed or misaligned doors and windows; and buckling of basement and retaining walls due to lateral forces. Extensive damage can potentially result in the condemnation of structures. (US Army 1983)

As part of the Multi-Jurisdictional Hazard Mitigation Plan Update, the City of Monmouth adopted natural hazard mitigation goals as shown in Table 1.

Table 1 - City of Monmouth Natural Hazard Mitigation Goals

Goal Number	Goal Description
1	**Public Education And Awareness:** *Provide public information and education/awareness to all residents of the city concerning natural hazard areas and mitigation efforts.*
2	**Preventive And Implementation:** *Develop and implement activities to protect human life, commerce, property, and natural systems.*
3	**Collaboration And Coordination:** *Strengthen hazard mitigation by increasing collaboration and coordination among citizens, public agencies, non-profit organizations, businesses, and industry.*
4	**Funding And Partnerships:** *Seek partnerships in funding and resources for future mitigation efforts.*
5	**Emergency Operations:** *Coordinate and integrate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures.*
6	**Natural Resources Utilization:** *Link land use planning, development criteria, codes, and natural resources and watershed planning with natural hazard mitigation.*

During the Multi-Jurisdictional Hazard Mitigation Plan Update process, a Steering Committee comprised of City staff, representatives from Fire District No. 1, Western Oregon University, and the Planning Commission reviewed and prioritized possible mitigation actions for each of the identified natural hazards. The mitigation actions considered by the Steering Committee are shown in Table 2. The Steering Committee also considered mitigation actions related to disruption of utility and transport systems, which is a common result of severe natural hazards, and hazardous materials (HAZMAT) incidents.

Table 2 - City of Monmouth Natural Hazard Mitigation Actions-Considered
(Listed in order of priority by hazard)

Hazard	Status	Comment	Description
Multi-Hazard	Consider	Top Priority	Establish and maintain a formal role for the jurisdictional Hazard Mitigation Steering Committee to develop a sustainable process to implement, monitor, and evaluate citywide mitigation actions.
Multi-Hazard	Ongoing	Second Priority	Develop and incorporate city ordinances commensurate with building and fire codes to reflect survivability from wind, seismic, fire, and other hazards to ensure life safety.
Multi-Hazard	Ongoing	Third Priority	Review ordinances and develop outreach programs to assure propane tanks are properly anchored and hazardous materials are properly stored and protected from known natural hazards such as seismic or flooding events.
Multi-Hazard	Ongoing	Fourth Priority	Purchase and install generators with main power distribution disconnect switches for identified and prioritized critical facilities susceptible to short term power disruption. (i.e. first responder and medical facilities, schools, correctional facilities, City Hall, and water and sewage pump stations, etc.).
Multi-Hazard	Consider	Fifth Priority	Based on known high-risk hazard areas, identify hazard-specific signage needs and purchase and install hazard warning signs near these areas to notify and educate the public of potential hazards.
Multi-Hazard	Completed		Review ordinances and develop outreach programs to assure mobile homes and manufactured buildings are protected from severe wind and flood hazards. (Anchoring, elevation, and other methods as applicable)
Multi-Hazard	Completed		Cross reference and incorporate mitigation planning provisions into all community planning processes such as comprehensive, capital improvement, land use, transportation plans, etc to demonstrate multi-benefit considerations and facilitate using multiple funding source consideration.
Multi-Hazard	Completed		Develop and incorporate mitigation provisions and recommendations into zoning ordinances and community development processes to maintain the floodway and protect critical infrastructure and private residences from other hazard areas.
Multi-Hazard	Completed		Increase power line wire size and incorporate quick disconnects (breakaway devices) to reduce ice load and windstorm power line failure during severe wind or winter ice storm events.
Multi-Hazard	Completed		Install lightning rods and lightning grade surge protection devices on critical electronic components such as warning systems, communications equipment, and computers for critical facilities.
Multi-Hazard	Consider		Develop, produce, and distribute information materials concerning mitigation, preparedness, and safety procedures for all natural hazards.
Multi-Hazard	Completed		Explore the need for, develop, and implement hazard-zoning ordinances for high-risk hazard area land-use.
Multi-Hazard	Consider		Retrofit structures to protect them from seismic, floods, high winds, earthquakes, or other natural hazards.
Multi-Hazard	Consider		Identify and pursue funding opportunities to implement mitigation actions.
Multi-Hazard	Consider		Develop public and private sector partnerships to foster hazard mitigation activities.
Multi-Hazard	Consider		Integrate the Mitigation Plan findings into planning and regulatory documents and programs and into enhanced emergency planning.

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Hazard	Status	Comment	Description
Flood			
Flood	Ongoing	Top Priority	Develop, or revise, adopt, and enforce storm water ordinances and regulations to manage run-off from new development, including buffers and retention basins.
Flood	Consider	Second Priority	Develop and maintain GIS mapped inventory, and develop prioritized list of residential and commercial buildings within 100-year floodplains.
Flood	Consider	Third Priority	Develop and maintain GIS mapped critical facility inventory for all structures located within 100-year floodplains.
Flood	Ongoing		Develop an outreach program to educate public concerning NFIP participation benefits, floodplain development, land use regulation, and NFIP flood insurance availability to facilitate continued compliance with the NFIP.
Flood	Ongoing		Develop, implement, and enforce floodplain management ordinances.
Flood	Consider		Increase culvert size to increase its drainage efficiency.
Flood	Ongoing		Construct debris basins to retain debris in order to prevent downstream drainage structure clogging.
Flood	Ongoing		Install debris cribs over culvert inlets to prevent inflow of coarse bed-load and light floating debris.
Flood	Ongoing		Create detention storage basins, ponds, reservoirs etc. to allow water to temporarily accumulate to reduce pressure on culverts and low water crossings. Water ultimately returning to its watercourse at a reduced flow rate.
Flood	Ongoing		Realign bridge piers & abutments to be parallel with the stream's centerline. This prevents pier and abutment undermining and reduces debris catchment.
Flood	Ongoing		Construct concrete wing walls at culvert or bridge entrances and outlets to direct water flow into their openings.
Flood	Consider		Provide flood protection to mitigate damage and contamination of wastewater treatment systems.
Winter Storms (includes Drought & ENSO actions)			
Winter Storms	Ongoing	Top Priority	Implement and enforce the most current Uniform International, and State, Building Codes to ensure structures can withstand winter storm hazards such as high winds, rain, water, and snow.
Winter Storms	Ongoing	Second Priority	Develop and implement tree clearing mitigation programs to keep trees from threatening lives, property, and public infrastructure from severe weather events.
Winter Storms	Ongoing	Third Priority	Update or develop, implement, and maintain jurisdictional debris management plans.
Winter Storms	Ongoing	Fourth Priority	Develop and implement programs to coordinate maintenance and mitigation activities to reduce risk to public infrastructure from severe winter storms.
Winter Storms	Ongoing	Fifth Priority	Develop, implement, and maintain partnership program with electrical utilities to use underground utility placement methods where possible to reduce or eliminate power outages from severe winter storms.
Winter Storms	Ongoing		Develop and implement strategies and educational outreach programs for debris management from severe winter storms.
Winter Storms	Ongoing		Develop critical facility list needing emergency back-up power systems, prioritize, seek funding,

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Hazard	Status	Comment	Description
			and implement mitigation actions.
Winter Storms	Ongoing		Develop and maintain severe winter storm public outreach program defining mitigation activity benefits through educational outreach aimed at households and businesses while targeting of special needs populations.
Winter Storms	Ongoing		Develop personal use and educational outreach training for a "safe tree harvesting" program. Implement along utility and road corridors, preventing potential winter storm damage.
Winter Storms	Ongoing		Purchase NOAA Weather radios and develop a web portal linking residents to various weather information sites. (NWS, FEMA, The Weather Channel).
Winter Storms	Consider		Develop early warning test program partnering with NOAA, City Police, Fire Departments, and Volunteer Fire Department to coordinate tests.
Winter Storms	Ongoing		Increase power line wire size and incorporate quick disconnects (breakaway devices) to reduce ice load power line severe wind or winter ice storm event failure.
Winter Storms	Consider		Review critical facilities and government building energy efficiency, winter readiness, and electrical protection capability. Identify, prioritize, and implement infrastructure upgrade or rehabilitation project prioritization and development.
ENSO	Consider	Top Priority	Educate public regarding weather patterns associated with El Niño / La Niña.
Drought	Ongoing	Top Priority	Develop educational programs and initiatives related to water conservation and irrigation during drought periods.
Wildland Fire			
Wildland Fire	Ongoing	Top Priority	Develop, adopt, and enforce burn ordinances that require burn permits, restrict campfires, and controls outdoor burning.
Wildland Fire	Consider		Develop outreach program to educate and encourage fire-safe construction practices for existing and new construction in high-risk areas.
Wildland Fire	Consider		Develop outreach program to educate and encourage home landscape cleanup (defensible space).
Wildland Fire	Consider		Reduce fire hazards by prohibiting back yard burning; this can be implemented by developing a citywide yard debris drop off program.
Earthquake			
Earthquake	Ongoing	Top Priority	Update the City Code to adopt, implement, and enforce current State of Oregon Building Codes.
Earthquake	Ongoing	Second Priority	Encourage utility companies to evaluate and harden vulnerable infrastructure elements for sustainability.
Earthquake	Consider	Third Priority	Disseminate FEMA pamphlets to educate and encourage homeowners concerning seismic structural and non-structural retrofit benefits.
Earthquake	Consider		Supplement State Seismic Needs Analysis data (schools, fire, law enforcement). Complete inventory of public and commercial buildings that may be particularly vulnerable to earthquake damage.
Earthquake	Consider		Identify high seismic hazard areas; develop a wood-frame residential building inventory and an

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Hazard	Status	Comment	Description
			outreach program to educate population concerning facilities particularly vulnerable to earthquake damage, such as pre-1940s homes and homes with cripple wall foundations.
Earthquake	Consider		Structurally retrofit important public facilities with significant seismic vulnerabilities, such as non-reinforced masonry construction (i.e. historic buildings)
Earthquake	Consider		Develop outreach program to educate residents concerning benefits of increased seismic resistance and modern building code compliance during rehabilitation or major repairs for residences or businesses.
Earthquake	Consider		Inspect, prioritize, and retrofit any critical facility or public infrastructure that does not meet current Building Codes.
Earthquake	Consider		Identify and prioritize a list of critical facilities with non-reinforced masonry problems including non-structural projects such as brick chimney bracing or replacement, water heater bracing, and anchoring, etc.
Earthquake	Consider		Evaluate critical public facility seismic performance for fire stations, public works buildings, potable water systems, wastewater systems, electric power systems, and bridges within the jurisdiction.
Earthquake	Consider		Develop outreach program for educating private facilities concerning alternative or emergency power source acquisition to enable them to deliver food, fuel, and medical services during disaster emergency response and recovery efforts.
Earthquake	Consider		Develop partnerships to mitigate hazards that result in jurisdictional facility lifeline or emergency transportation route closures.
Wind			
Wind	Ongoing	Top Priority	Identify and prioritize critical facilities' overhead utilities that could be placed underground to reduce power disruption from windstorm / tree blow down damage.
Wind	Ongoing	Second Priority	Enforce requirements to place utilities underground to reduce power disruption from windstorm / tree blow down damage when upgrading or during new development.
Wind	Consider	Third Priority	Identify alternate interoperable communication method as backup for emergency personnel when telephone lines are disrupted due to down power lines and cell phones are inoperable.
Wind	Consider		Review ordinances and develop outreach programs to assure mobile homes and manufactured buildings are protected from severe wind and flood hazards. (Anchoring, elevation, siting, and other methods as applicable)
Wind	Ongoing		Increase power line wire size and incorporate quick disconnects (breakaway devices) to reduce ice load power line failure during severe wind or winter ice storm events.
Erosion			
Erosion	Consider	Top Priority	Maintain and update erosion hazard locations, identify critical facilities potentially impacted and develop mitigation initiatives such as bank stabilization or facility relocation to prevent or reduce the threat.

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Hazard	Status	Comment	Description
Erosion	Ongoing	Second Priority	Develop and provide information to all residents on riverbank erosion and methods to prevent it in an easily distributed format.
Erosion	Ongoing		Install riprap, or pilings to harden or "armor' a stream bank where severe erosion occurs.
Erosion	Ongoing		Install bank protection such as rock, concrete, asphalt, vegetation, or other armoring or protective materials to provide riverbank protection.
Erosion	Ongoing		Develop an outreach program to educate the public concerning planting processes and materials used to stabilize hill slopes or stream banks. This is known as bioengineering, which uses logs, root wads, or wood debris or other vegetation to reduce scour and erosion.
Erosion	Ongoing		Harden culvert entrance bottoms with asphalt, concrete, and rock, to reduce erosion or scour.
Erosion	Ongoing		Install embankment protection such as vegetation, riprap, gabion baskets, sheet piling, and walls to reduce or eliminate erosion.
Erosion	Ongoing		Install walls at the end of a drainage structure to prevent embankment erosion at its entrance or outlet. (end walls).
Erosion	Ongoing		Construct a rock or concrete structure to dissipate energy or reduce flow velocity to prevent erosion of the streambed and banks.
Erosion	Ongoing		Install flared outlets or end sections at culvert entrances and outlets to match the embankment slope to reduce erosion and scour at the entrance and exit points during high flow.
Erosion	Ongoing		Install flow diverters a short distance into a water body, tied into the bank, designed to redirect water flow away from embankments to protect from erosion.
Erosion	Ongoing		Install channel lining using pipe, rock, concrete, or asphalt to reduce scouring embankments and ditch bottom erosion.
Erosion	Ongoing		Install bank revetment protection to prevent erosion.
Expansive Soils			
Expansive Soils	Consider	Top Priority	Review construction codes to require non-absorbent fill soils that slope away from foundations for a minimum of five feet to prevent ponding and water retention.
Expansive Soils	Ongoing		Require building design, engineering, and construction processes that address expansive soil conditions at potentially affected building sites.
Expansive Soils	Ongoing		Require road design, engineering, and construction processes that address expansive soil conditions. Water absorption prevention, impermeable membrane, soil compaction, and drainage methods need to be considered once geologic studies determine soil composition.
Expansive Soils	Ongoing		Develop educational programs and initiatives related to water conservation and irrigation during drought periods.
Technological Hazards			
Disruption of Utility and Transport Systems (DUTS)			
DUTS	Ongoing	Top Priority	Develop outreach program to educate and encourage residents to maintain several days of emergency supplies for power outages or road closures.

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Hazard	Status	Comment	Description
DUTS	Ongoing	Second Priority	Review and update emergency response plans for utility disruptions.
DUTS	Ongoing	Third Priority	Identify and prioritize all "jurisdiction owned" & "non-jurisdiction owned" critical facilities that have backup power and emergency operations plans.
DUTS	Consider		Review and update emergency response plans for transportation route disruptions.
DUTS	Ongoing		Purchase backup power systems for all identified critical facilities.
HAZMAT			
HAZMAT	Consider	Top Priority	Enhance emergency planning, emergency response training, and equipment acquisition to address hazardous materials incidents for emergency and first responders and Public Works staff.
HAZMAT	Consider		Annually review and update HAZMAT inventories and ensure that emergency responders are trained for site-specific incidents.
HAZMAT	Consider		Evaluate existing security measures for sites with large quantities of hazardous substances (HS) or any quantities of extremely hazardous substances (EHS) and enhance security as necessary.
HAZMAT	Consider		Evaluate seismic bracing/anchoring for sites with large quantities of HS or any quantities of EHS.
HAZMAT	Consider		Train Public Works staff to identify EHS and to follow EMS protocols.
HAZMAT	Consider		Develop outreach program to educate the public regarding chemical hazards, safe handling, storage, and disposal procedures.
HAZMAT	Consider		Research, develop, and implement methods to protect waterways from hazardous materials events.
HAZMAT	Consider		Prepare a site-specific summary of hazardous materials used, stored, and commonly transported in the jurisdictional area. The summary should include mapped facility locations with a hazardous materials inventory, emergency response protocols, and mitigation actions.
HAZMAT	Consider		Expand the hazardous materials drop-off program to include more than one drop off day per year.