

# The Oregon Climate Change Adaptation Framework

Summary of Key Findings and  
Recommendations





## The Oregon Climate Change Adaptation Framework

Climate variability and change have already begun to affect Oregon, including Oregon's marine environments, forestlands, agriculture, and transportation infrastructure. Over the next few decades, indicators show that Oregon's natural resources, infrastructure, and people will likely face more severe impacts from climate change.

Oregon's climate is marked by variability, and that variability alone has caused or contributed to significant ecosystem and economic damage to infrastructure through floods, landslides and forest fires. In addition to the effects of normal variability in Oregon's climate, significant changes in temperature, precipitation patterns, and other climate factors like ocean conditions are expected to increasingly affect Oregon's communities, natural resources, and economy. As with the effects of climate variability, long-term changes in climate conditions have the potential to result in very costly conditions and outcomes. Natural hazards, water supply problems, drought, habitat changes and loss of ecosystem services will all affect Oregon's citizens, communities, and economy. But fortunately, many of the potential costs and consequences of climate change may be anticipated and planned for. As such, it is both prudent and important to develop measures, programs and approaches to reduce the costs of climate variability and change on Oregon.

In October 2009, Governor Kulongoski asked the directors of several state agencies, universities, research institutions and extension services to develop a climate change adaptation plan. Among other things, the plan would provide a framework for state agencies to identify authorities, actions, research, and resources needed to increase Oregon's capacity to address the likely effects of a changing climate.

Given the broad range of expected changes to Oregon's climate in the coming decades, the breadth of state-level responsibilities, authorities, and programs that will likely need to respond to the effects of future climate conditions, and limited time, it has only been possible to begin the development of a climate change adaptation strategy for Oregon. This report constitutes a *framework* for the continued development of strategies and plans to address future climate conditions. This Climate Change Adaptation Framework provides context, identifies risks, lays out short-term priorities, and provides momentum and direction for Oregon to prepare for future climate change.

The framework has been developed in parallel with the Oregon Climate Assessment Report (OCAR) by the Oregon Climate Change Research Institute (OCCRI). The OCAR and this framework are intended to complement each other. The OCAR identifies the most likely impacts from climate change, which will help the state prioritize resources to prepare for and adapt to a changing and variable climate. The OCCRI assisted in the development of this Framework.

This Framework lays out expected climate-related risks, the basic adaptive capacity to deal with those risks, short-term priority actions, and several steps that will evolve into a long-term process to improve Oregon's capacity to adapt to variable and changing climate conditions. It will be necessary to continue to develop adaptation strategies and plans, in particular at the regional and local level. Finally, more effort needs to be made to identify resource management and economic opportunities that climate change might

present for Oregon. This Framework positions Oregon to take effective early steps to avoid some of the most costly potential consequences of climate change.

# The Oregon Climate Change Adaptation Framework

## Summary of Key Findings and Recommendations

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There is abundant evidence that Oregon is already experiencing the effects of climate change. The Oregon Climate Assessment Report documents these effects and describes the more pronounced changes that are expected to occur in the coming decades. Climate change will affect all Oregonians, all Oregon communities, our natural resources, and our businesses.

At the same time that climate change is beginning to affect us, state, local and private resources to begin to prepare for these changes are under historic stress. This interim report by the state recognizes these fiscal realities, and (as a result) focuses on providing decision-makers with information about what things are most important to do (or avoid doing) in an era of very limited resources. Only actions that involve little or no cost are proposed at this time, even though we also recognize that investments now may yield very substantial long-term benefits

This introduction to the Oregon Climate Change Adaptation Framework summarizes the key findings and recommendations of the participants in this initial effort to review the emerging science on climate change and evaluate what our priorities should be at a state-wide level in terms of preparing people, communities and resources for the coming changes. Among the key recommendations is that we broaden this work to include private sector interests along with our federal, tribal, and local counterparts. A major determinant of what new actions to recommend is our initial assessment of costs and benefits.

### History and Purpose

In early 2008 the Governor's Climate Change Integration Group (CCIG), made up of state, federal, and local government representatives, industry leaders, and nonprofit organizations, produced Oregon's *Framework for Addressing Rapid Climate Change*. The CCIG's framework presented the broad scope of needed work related to climate change in four elements: preparation and adaptation; mitigation; education and outreach; and research. At the time, Oregon had already made some progress in mitigation, and had begun to invest in research. Since then, there has been some further progress in mitigation and research, and some initial efforts related to preparation and adaptation.

In October 2009, Governor Kulongoski asked state agencies and partners in Oregon's University System to develop an initial framework for determining what the most important risks are to the state related to climate change, and initial recommendations for how to begin preparing for those risks. This Framework is the result of that initiative. The Climate Change Adaptation Framework is the first step in a long-term process to identify key risks and measures to reduce Oregon's vulnerability to the effects of climate variability and change. This framework presents a broad-scale qualitative assessment of risks to people, infrastructure, communities and natural resources that are expected to result from the effects of variable and changing climate conditions. More importantly, this framework identifies several concrete actions the state should consider taking to begin to prepare for and adapt to the effects of climate variability and change.

The purposes of this framework are to

- Identify likely future climate conditions that pose major risks for Oregonians.
- Assess the capacity of state programs to effectively address climate-related risks to people, communities, infrastructure, and natural resources.
- Identify short-term and low- or no-cost priority actions to prepare for those risks.
- Provide context and initial direction for additional coordination and planning for future climate conditions.

In developing this framework, Oregon has begun to address several of the CCIG's recommendations, including the following:

- Determine how climate change will affect Oregon's diverse regions.
- Assist Oregon institutions and individuals in responding to climate change.
- Transform our planning processes to deal with climate change.
- Incorporate the public health implications of climate change.
- Continue to develop and refine a climate change research agenda for Oregon.

This framework is only an initial step; it by no means completes the work needed to fully implement these recommendations. Considerable work will be needed, especially in collaboration with Oregonians, local governments, Native American tribal governments, and federal agencies, to fully address climate risks to Oregon.

## **Scoping Climate Risks**

In late 2009, an interagency work group was convened to develop this framework. The work group's first two tasks were to identify likely changes in Oregon's climate conditions and the likely consequences of those changes over the next 40 to 50 years. The work group identified several dozen likely changes in four areas: built and developed systems, ecosystems, public health and safety, and Oregon's economy. In consultation with the Oregon Climate Change Research Institute (OCCRI) and state agencies, the workgroup ultimately combined the likely changes in Oregon into eleven categories that are likely to occur over the next four to five decades. In this framework, these likely changes are defined as *climate risks*.

As the work group refined the inventory of risks, characterizing the risks to economic systems became more and more difficult. More to the point, very little information is available on the likely *economic* effects of climate change in Oregon. Risks to Oregon's economy that were identified by the work group were really risks to other systems restated in very general economic terms. In other words, climate-related risks to Oregon's economy reflected the economic consequences of risks to natural systems, built and developed systems, and public health and safety. In the end, while this framework attempted to include the economic effects of future climate conditions within its scope, there is little information available to do so with confidence at this point in time. Further collaboration with economists and organizations outside government is necessary to improve the assessment of the possible or likely economic consequences of climate change on Oregonians and the state at a whole.

The eleven climate risks listed below and in the table later in this Summary of Key Findings and Recommendations constitute the substantive foundation for the adaptation framework. Climate risks have varying degrees of likelihood; that is, not all the identified climate risks are equally likely to occur in Oregon. The risks are listed according to likelihood levels; the three levels of *Very likely*, *Likely*, and *More likely than not* correspond roughly to 90 percent, 66 percent, and 60 percent confidence levels, respectively. In planning for future climate conditions, it will be important to recognize variability and uncertainty in climate risks.

## Potential Consequences of Climate Risks

The work group compiled a survey of likely consequences for each climate risk. Some of the consequences are summarized below. The summaries are by no means exhaustive, but rather are intended to help identify state responsibilities and programs that will likely need to prepare for and adapt to the effects of climate change.

### Risks that are *Very likely* to occur

#### **Risk 1. Increase in average annual air temperatures and likelihood of extreme heat events.**

Overall, increased average air temperatures will result in increased water temperatures and reduced flows in streams, which over the long term will cause shifts in aquatic habitats, species, and communities. There is serious risk that increased average air temperatures will affect water temperatures and aquatic habitats to the extent that important core populations of salmonids will go extinct.

Heat waves will result in increased deaths and illness among vulnerable human populations. The elderly, infants, chronically ill, low income communities, and outdoor workers are the main groups threatened by heat waves. Higher temperatures increase the threat of human illness from both waterborne diseases and vector borne illnesses. In addition, heat waves, drought and changes in hydrology will contribute to an increase in the threat of wildfire, which will result in increased exposure of vulnerable populations to smoke. (See risk 8).

#### **Risk 2. Changes in hydrology and water supply; reduced snowpack and water availability in some basins; changes in water quality and timing of water availability**

Changes in hydrologic patterns in some Oregon basins will affect supplies of water for all uses, and will contribute to increased water quality problems. Reduced availability of water will affect junior irrigators, change water supply planning in many basins, and affect the quality and availability of water for some public drinking water systems. Proposals for surface water storage may increase.

Changes in the timing and quality of available water will affect aquatic, wetland, and riparian ecosystems and species, especially species that need adequate water in stream to survive and populations that are already identified as threatened or endangered. Hydrologic changes will exacerbate temperature-related water quality problems.

Water users suffering the most adverse consequences will be irrigators. Irrigated agriculture is a primary economic driver in Oregon, so without careful planning for the consequences of climate change, the Oregon economy may suffer significantly.

Changes in hydrology have the potential to significantly affect agricultural productivity until crops suited to new hydrologic conditions are developed.

## **Risks that are *Likely* to occur**

### **Risk 3. Increase in wildfire frequency and intensity**

Increased temperatures, the potential for reduced precipitation in summer months, and accumulation of fuels in forests due to insect and disease damage (particularly in eastside forests) present high risk for catastrophic fires. An increase in frequency and intensity of wildfire will damage larger areas, and likely cause greater ecosystem and habitat damage. Larger and more frequent wildfires will increase human health risks due to exposure to smoke.

Increased risk of wildfire will result in increased potential for economic damage at the urban-wildland interface. Wildfires destroy property, infrastructure, commercial timber, recreational opportunities, and ecosystem services. Some buildings and infrastructure subject to increased fire risk may not be adequately insured against losses due to fire. Increased fire danger will increase the cost to prevent, prepare for, and respond to wildfires.

### **Risk 4. Increase in ocean temperatures, with potential for changes in ocean chemistry and increased ocean acidification**

Ocean acidification will have a negative effect on some marine species and could result in dramatic changes in marine and estuarine ecosystems. Changes in temperature and upwelling may be positive for some species and negative for others off of Oregon. If there are large increases in hypoxia, there is a potential for significant restructuring of the ecological communities on the ocean floor off of Oregon. Population variation of many marine species is likely to increase due to direct biological effects of climate change and indirect cascading ecological effects.

### **Risk 5. Increased incidence of drought**

Longer and drier growing seasons and drought will result in increased demand on ground water resources and increased consumption of water for irrigation, which will have potential consequences for natural systems. Droughts affect wetlands, stream systems, and aquatic habitats. Drought will result in drier forests and increase likelihood of wildfire.

Droughts will cause significant economic damage to the agriculture industry through reduced yields and quality of some crops. Droughts can increase irrigation-related water consumption, and thus increase irrigation costs. Drought conditions can also have a significant effect on the supply of drinking water.

### **Risk 6. Increased coastal erosion and risk of inundation from increasing sea levels and increasing wave heights and storm surges**

Increased wave heights, storm surges, and sea levels can lead to loss of natural buffering functions of beaches, tidal wetlands, and dunes. Accelerating shoreline erosion has been documented, and is resulting in increased applications for shore protective structures. Shoreline alterations typically reduce the ability of beaches, tidal wetlands, and dunes to adjust to new conditions.

Increasing sea levels, wave heights and storm surges will increase coastal erosion and likely increase damage to private property and infrastructure situated on coastal shorelands. Coastal erosion and the common response to reduce shoreland erosion can lead to long-term loss of natural buffering functions of beaches and dunes. Applications for shoreline alteration permits to protect property and infrastructure are increasing, but in the long term they reduce the ability of shore systems to adjust to new conditions.

**Risk 7. Changes in abundance and geographical distributions of plant species and habitats for aquatic and terrestrial wildlife**

Changes in temperature and precipitation regimes will result in a gradual migration of some species and habitats north and to higher elevations. Species that cannot migrate or shift their range quickly enough to respond to climate change, or that have specific life-history needs that cannot be met through migration, will likely experience a decline in population numbers, potentially leading to extinction.

Changes in temperatures and hydrology will affect aquatic, wetland, and riparian ecosystems and species, especially species or population units that are already identified as threatened or endangered.

Risk of damage by insect and plant pests, which can result in significant damage to native species and communities, will increase with warmer temperatures. Alterations to the species composition of native ecosystems will likely result in a decline in important ecosystem services, including water quality and quantity, carbon storage, soil stabilization, flood control, and nutrient cycling.

**Risk 8. Increase in diseases, invasive species and insect, animal and plant pests**

Invasive species can negatively impact native plants, fish, and wildlife in agricultural ecosystems by displacing native species, changing habitat characteristics, consuming significant amounts of water, and changing fire regimes. Invasive species are already very costly to Oregon's forests, grasslands, and wetlands, and agricultural economy.

Spread of infectious diseases in the United States and in the Pacific Northwest is occurring, with increased vulnerability of human populations to existing and emerging conditions. The West Nile Virus, Hanta Virus and Cryptococcus Gattii have all emerged recently in the Pacific Northwest.

**Risk 9. Loss of wetland ecosystems and services**

Wetlands play key roles in major ecological processes and provide a number of essential ecosystem services, such as flood reduction, groundwater recharge, pollution control, recreational opportunities, and fish and wildlife habitat, including for endangered species. Only about 38 percent of the wetlands that were in Oregon at the start of European settlement remain as wetlands today, because of conversions for various other land uses. As such, increases in air temperature and changes in hydrology will exacerbate impacts to already degraded and fragmented wetland ecosystems. The consequences for losing wetland ecosystems and their associated services will potentially affect all of Oregon's systems—natural, built and developed systems, public health and safety, and Oregon's economy.

Examples of the effects of a loss or reduction in wetland ecosystem services include increased flood damage to residences, commercial buildings, bridges, culverts, and roadways; increased need for new and expanded drinking water treatment facilities; and increased need for water storage facilities for flood control and to meet seasonal water demand.

The loss of wetland ecosystems and services will have indirect consequences on a range of economic activities. Loss of coastal wetlands that provide habitats can eventually reduce the value of Oregon's commercial and recreation fishing industries. Loss of seasonal wetlands and coastal wetlands will impact waterfowl and shorebird populations and may reduce the revenue generated from hunting, birding, and other recreation activities. Loss of wetlands that provide flood protection may result in higher damage costs as a result of increased flood related damages. Loss of wetlands that purify water may result in the need for expanded or additional drinking water treatment facilities. Loss of wetlands that provide water storage may result in the need for the construction of expanded and additional infrastructure to prevent flooding and to meet summer time water demands.

### **Risks that are *More likely than not* to occur**

#### **Risk 10. Increased frequency of extreme precipitation events and incidence and magnitude of damaging floods**

Extreme precipitation events have the potential to cause localized flooding due partly to inadequate capacity of storm drain systems. Extreme events can damage or cause failure of dam spillways. Increased incidence and magnitude of flood events will increase damage to property and infrastructure, and will increase the vulnerability of areas that already experience repeated flooding. Areas thought to be outside the floodplain may now experience flooding. Many of these areas have improvements that are not insured against flood damage, and thus floods will probably result in catastrophic property damage and losses. Finally, increased flooding will increase flood-related transportation system disruptions, thereby affecting the distribution of water, food, and essential services.

#### **Risk 11. Increased incidence of landslides**

Increased landslides will cause increased damage to property and infrastructure, and will disrupt transportation and the distribution of water, food, and essential services. Widespread damaging landslides that accompany intense rainstorms (such as "pineapple express" winter storms) and related floods occur during most winters. Particularly high-consequence events occur about every decade; recent examples include those in February 1996, November 2006 and December 2007.

### **Selecting Short-Term Priority Actions**

Once the work group finalized its inventory of climate risks, the next tasks were 1) to assess the basic state agency capacities to address the identified risks; and 2) to compile a list of immediate or short-term actions that are needed to improve Oregon's capacity to address the risks. This effort was primarily an initial scoping exercise. Over the course of about two months in early 2010, the work group listed about 120 mostly short-term actions that are needed to effectively address the identified risks. Finally, resource

considerations made it paramount to limit the list of needed actions to a few relatively low-cost actions. All the identified actions are listed in summary form under each risk in section 2 of the framework.

Clearly, given the state general fund budget situation that has developed since early 2010, new resources are not likely to be available to implement any more than only a few of the needed actions, if any. It thus became necessary to identify a limited set of *top priority, short-term, low-cost actions* from the list. In consultation with agency directors, the work group prioritized needed actions according to the estimated costs and benefits of each one relative to all the other actions. In selecting priority actions, the workgroup based its assessment on a very general idea of the *relative magnitude of the costs and benefits* for each of the actions. In attempting to narrow its focus on low cost, high benefit actions, the work group assigned high, medium, and low cost and benefit values to each action, *relative* to the costs and benefits of the other actions, using the following guidelines in the evaluation:

#### **Costs**

- Costs to the state: The approximate personnel cost to implement the action.
- Costs to private landowners and businesses: Costs to private parties and businesses of implementing the action.
- Costs to the public *and* to particular communities: All other costs to the public, including infrastructure costs and costs to local governments.

#### **Benefits**

- Higher priority actions respond to *higher* likelihood of risks.
- Avoided costs: Reduced losses and damage from climate conditions that will be achieved in a 30-40 year timeframe if the actions are implemented now.
- Higher priority actions address the effects of more than one risk.

Finally, after compiling the information on risks, needed actions, and the relative costs and benefits of a set of “first cut” needed actions, the agency directors overseeing development of the framework made a final selection of *short-term priority actions*, which are central to the framework, for implementation in the 2011-2013 biennium.

More time and considerably more detailed information about the costs and likely benefits of needed actions are needed to improve the process of identifying priority actions. The work group’s inventory of gaps and actions is by no means exhaustive, nor is it intended to be the last word in identifying climate change adaptation priorities. This framework represents a starting point and initial assessment of state capacity to deal with present and future climate risks.

The table on the following pages lists the short-term priority actions needed to improve Oregon’s capacity to address the identified climate risks.

<b>Climate Risks and Short-Term Priority Actions</b>	
<i>Very likely to occur</i>	
<b>1.</b>	<b>Increase in average annual air temperatures and likelihood of extreme heat events</b>
	Enhance and sustain public health system capacity to prepare for and respond to heat waves and smoke emergencies, and improve delivery of information on heat events and cooling centers, especially for isolated and vulnerable populations.
<b>2.</b>	<b>Changes in hydrology and water supply; reduced snowpack and water availability in some basins; changes in water quality and timing of water availability</b>
	Maintain the capacity to provide assistance to landowners to restore wetlands, uplands and riparian zones to increase the capacity for natural water storage.
	Improve real-time forecasting of water delivery and basin yields to improve management of stored water.
	Improve capacity to provide technical assistance and incentives to increase storage capacity and to improve conservation, reuse, and water use efficiency among all consumptive water uses.
<i>Likely to occur</i>	
<b>3.</b>	<b>Increase in wildfire frequency and intensity</b>
	Include wildfires in planning to reduce vulnerability to natural hazards.
	Restore fire-adapted ecosystems to withstand natural recurring wildfires.
	Develop short- and medium-term climate change adaptation strategies for forests and other fire-prone habitats, and improve development standards to reduce exposure to fire risk at the urban-wildland interface.
	Improve the capabilities of public health agencies to plan for and respond to the public health and safety risks of wildfire emergencies.
<b>4.</b>	<b>Increase in ocean temperatures, with potential for changes in ocean chemistry and increased ocean acidification</b>
	Increase research on the impacts of changes in ocean temperature and chemistry on estuarine and near-shore marine habitats and resources, including commercial and recreational fisheries.
<b>5.</b>	<b>Increased incidence of drought</b>
	Improve capacity to provide technical assistance and incentives to increase storage capacity and to improve conservation, reuse, and water use efficiency among all consumptive water uses.

<b>6.</b>	<b>Increased coastal erosion and risk of inundation from increasing sea levels and increasing wave heights and storm surges</b>
	Inventory and map coastal shorelands that are at risk of erosion or inundation, or are barriers to shoreline migration, and develop long-term state and local adaptation strategies for shorelands.
<b>7.</b>	<b>Changes in the abundance and geographical distributions of plant species and habitats for aquatic and terrestrial wildlife</b>
	Identify ways to manage ecosystems that will improve their resilience to changes in climate conditions.
<b>8.</b>	<b>Increase in diseases, invasive species, and insect, animal and plant pests</b>
	Increase monitoring, detection and control measures for pest insects and plant and wildlife diseases.
	Increase surveillance and monitoring for climate-sensitive infectious diseases to humans.
	Increase outreach and community education about disease and invasive species prevention measures.
	Seek new means of securing resources to detect and combat diseases and invasive species.
<b>9.</b>	<b>Loss of wetland ecosystems and services</b>
	Support implementation of priority actions for Risks 2, 5, 6, 7, and 10 related to hydrologic changes, drought, coastal erosion and inundation, habitats, and flooding.
<i>More likely to occur than not</i>	
<b>10.</b>	<b>Increased frequency of extreme precipitation events and incidence and magnitude of damaging floods</b>
	Inventory past flood conditions and define and map future flood conditions.
	Improve capability to rapidly assess and repair damaged transportation infrastructure, in order to ensure rapid reopening of transportation corridors.
<b>11.</b>	<b>Increased incidence of landslides</b>
	Develop public education and outreach on landslide risks and how to adapt to landslide risks.

### **Existing Adaptive Capacity**

The state and local communities are not without resources already to begin to adapt to the effects of climate change. Important elements of Oregon's basic capacity to adapt to the effects of future climate conditions include the following:

- Oregon has a strong capacity at present to respond to wildfires.

- Oregon is making investments to restore and protect ecosystem services like habitats, riparian structure, and wetlands, which will reduce or mitigate the effects of future climate conditions on people, communities and infrastructure.
- Oregon’s wetland and waterway regulatory program protects important ecosystem services that will become increasingly important in a changing climate.
- There is some capacity at the state and local level to respond to emergency events like floods, fires, and windstorms to reduce damage and loss of life.
- Local land use plans are required to identify significant natural resources—including wetlands and riparian areas—that help reduce or mitigate the effects of future climate conditions on people, communities and infrastructure.
- Local land use plans are required to identify natural hazards that are subject to climate change, like flood, landslides, and coastal erosion.
- Oregon has an extensive network of state and county public health officials and authorities.

The current and future ability to successfully adapt to climate risks will rely in part on maintaining these and other program capabilities at the state level.

## **Implementing the Framework**

Implementing the short-term priority actions will get Oregon started on a long-term path to improve community resilience across the state. Implementing the priority actions will begin the process of factoring information on climate risks into a broad suite of decisions at the federal, tribal, state and local level that affect land use, infrastructure, and natural resources over the next 30 to 40 years. But if implementation of the framework is limited to just the priority actions, several important issues will remain unaddressed. The framework includes a series of recommendations related to these issues, which themselves are not tied exclusively to any one risk.

### ***1. Identify Research Needed for Management***

Just like all planning efforts, the anticipated future conditions that form the foundation for the framework involve some uncertainty. Further planning for climate change should involve continued identification of needed research to help ensure that measures being considered are the most appropriate measures. In particular, research is needed on the potential economic costs and benefits of alternative adaptation strategies.

#### ***Recommendation for Research***

- Compile an inventory of research needed to improve the effectiveness of adaptation measures at the state and local levels.

### ***2. Monitoring for Management***

Monitoring is an underappreciated element of effective resource management. Oregon agencies draw on information from many sources, and may monitor a variety of conditions, to improve agency efficiencies and the management of resources. The foundation of information for managing natural resources and state infrastructure could be improved, however, and such improvements will almost invariably improve Oregon’s ability to respond to the effects of future climate conditions.

***Recommendation for Monitoring***

- Compile an inventory and maps of current surveillance (for diseases) and monitoring (for environmental conditions) efforts, and assess the feasibility of integrating different monitoring efforts into a statewide monitoring system.

**3. *Agency Program Assessments***

State agencies already have some important capacities to prepare for, respond, and adapt to the effects of future climate conditions. However, the challenge that climate variability and change present to Oregon agencies is that conditions are changing faster than has generally been experienced before. Therefore, it is important that agency policy, program, and permit choices in the future incorporate information about likely future climate conditions, so as to avoid policies that might have clear climate-related future costs.

***Recommendation for Agency Program Assessments***

- State agencies should undertake an initial broad-scale assessment to identify policy and program elements that could result in decisions that place people, resources or infrastructure at risk.

**4. *Integrating Economic Information into Adaptation Planning***

Development of this framework has been somewhat hampered by the absence of reliable information about either 1) the economic costs of projected changes to Oregon's climate, especially over time; and 2) the likely cost to effectively respond to such changes, especially at the local level. The framework had to be developed on the basis of the estimated magnitude of costs—of both the effects of climate conditions and actions to address those effects—relative to other effects and actions. It is necessary to improve the economic foundation for future adaptation planning.

***Recommendation for Economic Information***

- Agencies should work with economists and climate adaptation specialists and existing groups or institutes with expertise in economics to compile a white paper to frame the economic questions, analyses, and data that can be used to improve the effectiveness of planning for climate variability and change.

**5. *Mainstreaming Adaptation***

Climate variability and change will affect all of the agencies that developed this framework and nearly every sector of Oregon's economy in the coming decades. Mounting and maintaining an effective response effort within state government will require ongoing coordination and collaboration between agencies. Given the continuing long-term challenge, climate preparation and adaptation needs to be 'mainstreamed' into agency programs and operations.

***Recommendation for Mainstreaming Adaptation***

- The agency directors' group and the interagency work group that have developed the framework should be formalized. The directors, as a steering group, should provide oversight for the coordinated implementation of the short-term priority actions and the implementation recommendations outlined here.

## **6. *Intergovernmental Coordination***

Building resilience to the effects of climate change will require coordination among all levels of government, and should include non-government entities as well. The most effective adaptation strategies will be implemented at the local or regional level, but may well be a function of state or federal initiatives. The private and non-profit sectors will also be actively engaged at the local, statewide, and national scale in building resilience in areas such as the economy and social welfare. Activities at all levels will need to be coordinated to assure cost effectiveness and to avoid working at cross-purposes.

### ***Recommendation for Intergovernmental Coordination***

- Oregon state agencies should consult with federal agencies, Native American tribal governments, representatives of local governments, and the private and nonprofit sectors to identify ways to coordinate the implementation of climate adaptation initiatives.

## **7. *Integrating Adaptation and Mitigation Strategies***

There is very little in the way of credible scientific challenge to the conclusion that much of the change in climate at the global scale is being driven by increased carbon dioxide emissions from the combustion of fossil fuels. One of the priority overarching actions of an adaptation framework should be to renew the commitment to reducing the generation of greenhouse gasses. Implementation and future revisions of the Framework should involve collaboration with the bodies that have principal responsibilities for implementing Oregon's Roadmap to 2020 developed by the Oregon Global Warming Commission.

### ***Recommendation for Integrating Adaptation and Mitigation Strategies***

- Over the next year, state agencies and the OGWC should assess existing emission reduction strategies to determine how best to incorporate climate change preparedness considerations.

## **8. *Communications and Outreach***

Given the breadth of Oregon's exposure to the effects of climate variability and change, the somewhat unpredictable nature of some climate-related events, and the potential to make decisions that increase vulnerability to various effects of climate change, it is critical to increase communications and outreach with the public about preparing for climate change. Communication and outreach efforts to inform Oregonians about the likely effects of future climate conditions should include information on how individuals and communities can reduce exposure to climate-related risks, and on how individuals can become involved in community-level efforts to prepare for climate change.

### ***Recommendation for Communications and Outreach***

- State agencies and the OGWC should collaborate on ways to improve messaging and outreach to the public related to preparing for climate change.

These next steps are designed to build the long-term infrastructure within Oregon state government needed to address climate impacts that will continue to affect Oregonians in

the coming decades. These next steps, in conjunction with the short-term priority actions, represent the beginning of Oregon's effort to build resilience into every element of Oregon's economy and the natural and governance systems that sustain it.

### **The Framework Report**

The Climate Change Adaptation Framework report contains more information than can be presented in this brief Summary of Key Findings and Recommendations. Please refer to the framework report for additional detail on

- The need to plan for variable and changing climate conditions.
- A summary of the scientific research related to each risk.
- Information on the time scale for the risk.
- Additional likely consequences of the risk.
- Agency actions that address the risk.
- Additional needed actions.
- Details on implementing the priority actions.

The Framework is an important first step in a collaborative state-level effort to address the challenges of preparing for and adapting to variable and changing climate conditions in Oregon. It lays the groundwork for expanded collaboration and coordination at all levels of government, and with citizens and the private and nonprofit sectors.



## Adaptation Framework: Participating Agencies

Agency	Agency Directors Team	Work Group
Department of Agriculture	Katy Coba	Stephanie Page
Department of Energy	Bob Repine	Bill Drumheller
Department of Environmental Quality	Dick Pedersen	Annette Liebe
Department of Fish and Wildlife	Roy Elicker	Holly Michael Sara O'Brien (contract) Dave Fox
Department of Forestry	Marvin Brown	Andrew Yost
Department of Geology and Mineral Industries	Vicki McConnell	Don Lewis
Department of Human Services Public Health Division	Mel Kohn	Michael Heumann
Department of Land Conservation and Development	Richard Whitman Jim Rue	Bob Rindy Jeff Weber
Parks and Recreation Department	Tim Wood	Jim Morgan
Department of State Lands	Louise Solliday	Anna Buckley
Department of Transportation	Matthew Garrett	Margi Lifsey Elizabeth Hormann
Water Resources Department	Phil Ward	Barry Norris
Oregon Watershed Enhancement Board	Tom Byler	Greg Sieglitz
Oregon Climate Change Research Institute	Phil Mote	Kathie Dello
Climate Leadership Initiative	Bob Doppelt	Roger Hamilton Steve Adams
Oregon Sea Grant	Dr. Stephen Brandt	Pat Corcoran
Oregon State University Extension Service	Scott Reed	
Oregon State University Institute for Natural Resources	Lisa Gaines	Bobby Mauger
Global Warming Commission	Angus Duncan	
Office of the Governor	Mike Carrier	Ivo Trummer Christine Valentine
Business Oregon	Tim McCabe	