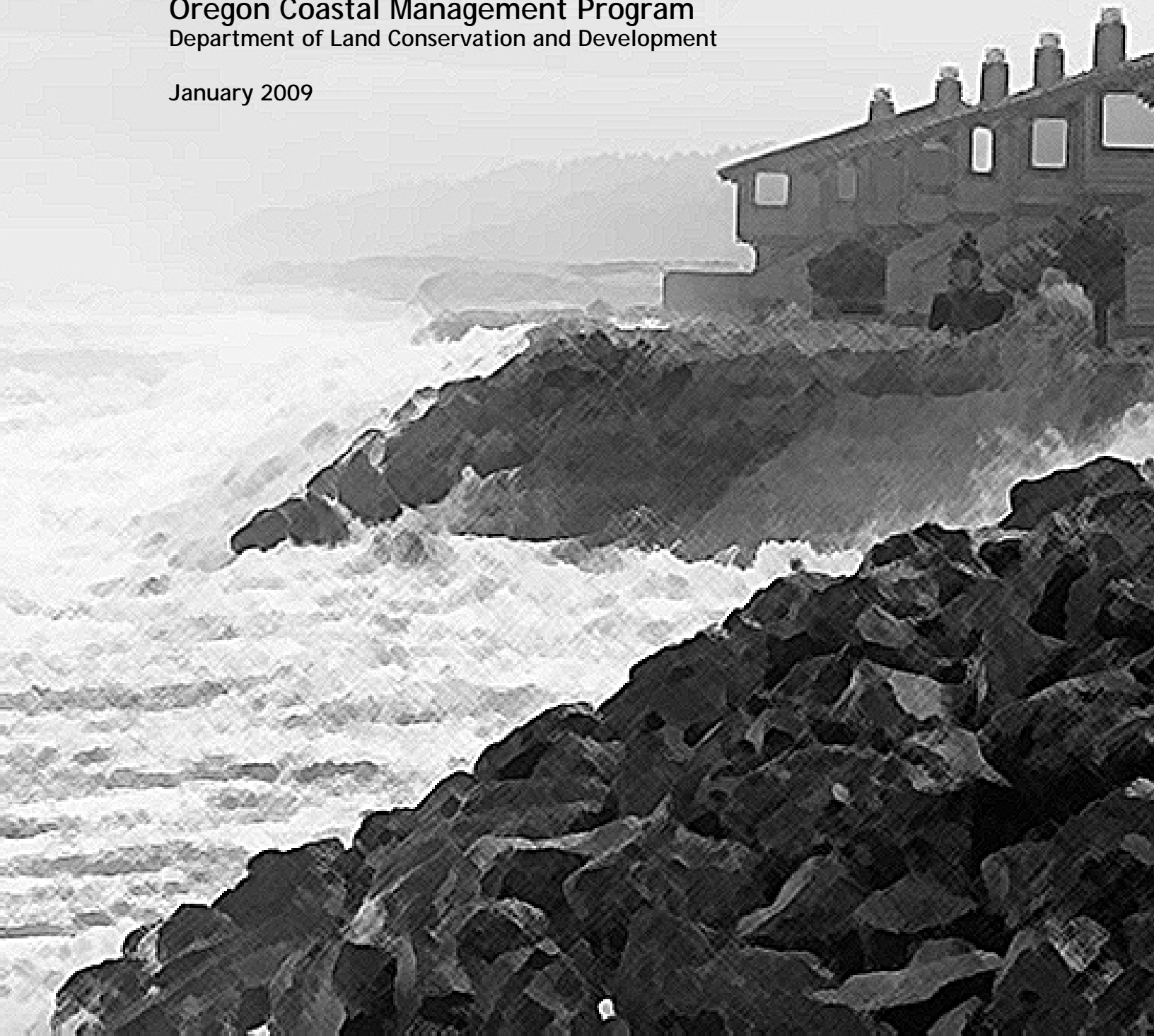


CLIMATE READY COMMUNITIES

A Strategy for Adapting to Impacts of Climate Change on the Oregon Coast

Oregon Coastal Management Program
Department of Land Conservation and Development

January 2009





COVER: Development in Neskowin under siege during a storm in December 2007.

Ocean shorefront properties are highly vulnerable to sea level rise and severe winter storms. Climate change is expected to exacerbate existing conditions.

Introduction

We offer this strategy to help coastal decision-makers, legislators, and the public look ahead to possible effects of global climate change on the Oregon coast and to help frame a process for coastal communities and agencies of the State of Oregon to work together to plan for those effects. Our goal is resilient, Climate-Ready Coastal Communities.

An almost overwhelming amount of information about climate change and likely effects is available in scientific journals, agency reports, and on the Internet. We have prepared a background report to accompany this strategy that contains a more detailed discussion of the available information about the science of climate change and its likely effects. Our report provides many references for further information.

Even with this vast amount of information, uncertainty is the hallmark of climate change, particularly as we look to the Oregon coast. The Earth's climate is a complex, dynamic machine undergoing rapid change. And although historical data, broad trends, and scientific models all point to similar conclusions about likely future effects on the Oregon coast, whether sea level rise, changes in rainfall patterns, or ocean acidification, these conclusions cannot be used to predict specific effects at a particular location or at a particular time on the Oregon coast. Our crystal ball is just not that good.

However, enough information exists to begin to focus public policy and planning capacity on the future effects of climate change, to assess vulnerabilities and evaluate risk, and make decisions that account for likely future conditions. Oregon's local

governments and state agencies are well versed in planning and have some capacity that can be mobilized for this work although, clearly, additional resources and information are needed. It is our intent to use this strategy to stimulate a serious discussion to begin the work of planning for Climate-Ready Communities.



Winter flood conditions preview what is likely to be an increasingly common condition as sea level rise also increases tidal elevations in estuaries and coastal lowlands.

The case for adaptation planning

Coastal Communities Are Vulnerable

Climate change will affect Oregon's coastal environment and communities and place lives and property at risk. City councils and county commissions will be called upon to make decisions about public infrastructure, such as highways, bridges, sewage treatment facilities, and airports that are determined to be vulnerable.

Similarly, private property, ranging from oceanfront homes and hotels to shopping centers, industrial sites, and dairy operations around estuaries, will be affected. Landowners need to understand how climate change may affect their property and be prepared to make decisions about how to respond and adapt.

Impacts Will Vary by Location

The effects of climate change will vary over time and from place to place. Exactly how, where, and when these effects will play out is difficult to predict. The local expression of sea level rise, in particular, will vary widely because the geologic setting of each coastal community is unique.

Ocean front communities on the north coast, where the coastline is subsiding relative to sea level, will be affected differently than communities on the south coast where the coastline is rising or stable relative to sea level rise.

Communities built on low-lying lands adjacent to estuaries will be affected by rising tidal elevations and the potential for increased flooding from more powerful storms. Other changes will be less obvious, such as invasions of non-native species and changes in forest cover.

Oregon Has Local Planning Tools

Oregon is well positioned to begin to take action to address these likely coastal impacts. Oregon's local governments have plan-

ning experience and capacity which provide a ready framework for planning to reduce effects of coastal hazards. Local plans already account for a variety of natural hazards and have maps and other data about these hazards. Some of the impacts of climate change, especially sea level rise, will play out over decades, providing time for local assessment, planning and adaptation actions.

Resources are Needed

Oregon is not, at present, well positioned in two key aspects. First is funding to develop necessary state and local capacity, obtain and apply specific technical information, and involve the public in preparing for climate change. Second is specific data to enable coastal communities and state agencies to determine the vulnerability of each community, assess risk from various potential impacts, and monitor changes over time.

Resilience Requires Action Now

The long time frames inherent in some effects of climate change appear to reduce the need to begin adaptation planning. But ensuring the resiliency of coastal communities in the face of unpredictable changes and difficult choices requires that the state and local governments begin now to plan for the impacts of climate change.

Public and private decisions about infrastructure and development made today will have consequences decades into the future. More options exist today for state and local governments than will likely exist in the future as conditions change and options become foreclosed. Local governments and state agencies can begin now to consider the effects of climate change over the life of the land use or investment decisions, and incorporate measures to reduce or avoid risk.



Many coastal highways and roads are vulnerable to effects of climate change.

Adaptation Strategy

This strategy for adaptation sets the stage for coordinated planning and action by coastal cities and counties, state agencies, and businesses, individuals, and non-governmental organizations. It frames basic steps needed to prepare adaptation plans and to implement them over time.

Statewide Framework

The starting point for this coastal adaptation strategy is the 2008 report from the Governor's Climate Change Integration Group (CCIG), [*A Framework for Addressing Rapid Climate Change*](#), which recommended several key actions, including:

1. Use Oregon's land use planning processes to address climate change:

Add consideration of climate change as a key element in current planning and decision-making processes.

Modify planning and decision-making processes so they are conducted on a holistic basis that considers multiple interconnected systems simultaneously.

Develop dynamic planning and decision-making processes, with preparation and adaptation to change as a cornerstone.

2. Immediately begin preparing for climate change:

Require and encourage all government agencies to adopt and implement climate change preparation plans

3. Determine how climate change will affect Oregon's diverse regions:

Develop localized climate change assessments that focus on impacts of a changing climate, adaptation and preparation needs, and mitigation opportunities

4. Assist Oregon institutions and individuals in responding to climate change:

Support integrated local government planning for both greenhouse gas mitigation and climate change preparation and adaptation

Principles

(based on final report of the Oregon Climate Change Impact Group):

- **Prevent**

Prevent impacts from climate change by assessing potential vulnerabilities of natural, built, economic and human systems and then take steps to increase community resiliency.

- **Prioritize**

Infrastructure and natural systems already stressed by non-climate factors are likely to be more vulnerable to climate impacts. Repairing or upgrading critical infrastructure already at risk should be a priority.

- **Take action now**

Incorporate projected effects of climate change into all existing programs and policies.

- **Plan long term**

Climate preparation planning should anticipate at least 10-25 and even 50-75-year scales, especially if major investments are being made in infrastructure.

- **Take a broad view**

Planning to increase resilience to climate impacts must consider a wide range of factors as with all other land use planning.



Public and private infrastructure, such as docks, airports, and municipal sewage treatment plants will be vulnerable to effects of climate change, particularly sea level rise.

Coastal Adaptation Strategy

Goal

To provide a framework for coordinated action between coastal local governments, state agencies, the public, and stakeholders to identify, assess, and plan for effects of climate change on the Oregon coast.

Objectives

- To enable coastal local governments to prepare adaptation plans by 2015 to account for the effects of climate change on property, infrastructure, habitats, and resources; and*
- To ensure that public infrastructure and investment decisions made by the State of Oregon are coordinated with local government climate change adaptation plans.*

Actions to Achieve the Strategy

Utilize Oregon's existing planning program

Assist local government planning

Three steps are key to local adaptation plans and community resilience:

1. Identify vulnerability,
2. Assess risks, and
3. Adopt appropriate response measures.

Coastal cities and counties will require financial, technical, and planning assistance to carry out these three steps to adopt robust adaptation plans within a reasonable time-frame and, over time, up-date them as new information is acquired. Formal adoption will be essential to integrate the community's planned response to climate change into local land use decisions, policies, regulations, functional plans, and, perhaps most important, public infrastructure investments. Local plans will also help determine what actions by state and federal agencies will be needed to respond to local climate impacts.

Acquire needed information

Adaptation planning will require a wide variety of data, studies, and information in mapped, modeled, and descriptive form. Some information about land use, infrastructure, and resources needed for planning is available to support local planning. Other critical data, such as detailed topographic data and imaging of the ocean shore, estuarine lands, and coastal flood plains are not yet available. Detailed data on ocean and estuarine shore configuration, shore protective structures, dikes, bulkheads, and sea level interaction are available in some but not all areas. Beach monitoring data are not available at a meaningful scale to model the potential effects on ocean shorelands and estuarine areas of rising sea level, storm surge, and larger waves.

NOTE: The Oregon Coastal Management Program will work with local governments, state and federal agencies such as the Department of Geology and Mineral Industries, universities, South Slough National Estuarine Research Reserve, and the National Oceanic and Atmospheric Administration to obtain needed financial resources, acquire data needed for adaptation planning, and provide these data in GIS format to local governments and state agencies.

Enhance local planning and technical capacity

Coastal local governments will require significant enhancement in staff capacity to assist planning commissions and city or county decision-makers to develop adaptation plans in a timely way. Staff resources are needed to acquire and use new information, work with the public and stakeholders, develop technical and information products, and prepare planning options for decision-makers. Because of limitations in funding at the local level, additional funding is needed from state and federal sources to ensure that coastal cities and counties have enhanced planning and technical capacity.

State agencies, too, will require additional staff capacity and expertise to develop and provide needed information to local governments and to develop and carry out programs to address climate change effects on resources, programs, or activities for which they are responsible.

Involve the public

Because many of the anticipated effects of climate change on the Oregon coast are likely to affect specific communities, property owners, and stakeholders, it is essential to engage and involve the public in planning for climate change impacts. In addition, public support for measures to reduce or mitigate the causes of greenhouse gasses is crucial to successful implementation. Web-based communication and information technologies, including the Oregon Coastal Atlas, can be useful tools to help communicate with and provide information about climate change and potential effects on the community.

Coordinate programs and activities

Many state and federal agencies have direct interests in adaptation planning in ways that overlap or depend on each other. Coastal local governments rely on coordination and cooperation of various state and federal agencies for information, technical assistance, or program support. Ensuring coordinated, mutually supportive efforts among all affected agencies will be a critical activity to leverage public funds, avoid conflicting efforts, and increase public confidence in new measures.

NOTE: The Oregon Coastal Management Program is uniquely positioned to coordinate activities among federal, state, and local programs. A Coastal Climate Change Coordinating Committee should be formed under the auspices of the state Global Warming Commission, facilitated by the Oregon Coastal Management Program.

Create new approaches

Over time, some of the likely effects of climate change, such as substantially higher tidal elevations in estuaries, may create unprecedented conditions in coastal communities. New legal or policy tools will be needed to address complex and unprecedented conditions created by rising sea level and tidal elevations or changes in vegetation and distribution of habitats. Other tools may be technical and involve ocean observing technologies and modeling to project future conditions and effects. Innovative approaches may be needed to adapt the requirements of the statewide planning program and other laws to the realities of climate change.



Coastal beaches will migrate landward with increased sea level and more frequent and severe winter storms. Rip-rap and other shoreline protective structures may provide relatively short term solutions. Eventually, protected properties will become peninsulas and increasingly vulnerable to wave overtopping.

The Likely Effects of Climate Change on the Oregon Coast

Climate and the Oregon Coast

The likely effects of climate change on the Oregon coast may come as no surprise to Oregonians who are familiar with winter storms and the variability of the climate and ocean conditions on the Oregon coast. The El Niño climate events of 1982-83 and 1997-98 gave Oregonians a taste of higher sea level, stronger storms, warmer ocean temperatures, and altered marine ecosystem.

Oregon's coastal communities have begun to experience the effects of climate change in the form of higher wave heights, more powerful winter storms, and major ocean shoreline erosion. Other phenomena are expected due to the Earth's changing climate such as rising sea level and tidal height, hypoxic nearshore ocean waters, seasonal temperature changes, more acidic ocean waters, and changes in forest cover.

It is important that coastal communities understand the potential effects of climate change in order to take action to avoid risks, reduce damage and make choices that will maximize community resilience. This paper outlines some of the principal ways that the Oregon coast is likely to be affected.

Key Physical Changes in Oregon's Coastal Climate and Weather

Changes in Earth's climate, driven by atmospheric warming caused by greenhouse gases, will affect the climate and weather of the Oregon coast in a variety of ways, some familiar, others dramatically new. Exactly how these changes will affect any particular community or region of the coast cannot now be accurately predicted. However, scientific evidence strongly suggests that coastal climate and weather are likely to change in four principal ways.

- **Temperature**

The current best estimate for future warming is about 0.5° F *per decade*, at least in the next few decades. The Pacific Northwest is projected to have greater warming during summer than in the winter. The mean temperature may increase significantly beyond current ranges over the course of the next century

- **Storms**

Data show that both the frequency and intensity of storms have increased in recent years, and individual storms are producing higher waves and storm surges. Projected changes suggest that future winter storms may be similar to recent strong El Niño-influenced storms that accelerated coastal erosion. More frequent, longer and more intense storms will cause greater damage.

- **Sea level**

Sea level is expected to rise significantly by 2100 but how much cannot now be predicted for any given location. Average sea level rose worldwide about 6.7 inches in the 20th century. A recent report concluded that sea level could rise on the Washington coast by 22 inches by 2050 and by 50 inches by 2100. The most current projections do not include the effects of rapid ice melt being experienced in Greenland or Antarctica. Sea level rise will generate increased tidal heights in estuaries and coastal rivers that are affected by tides.

- **Precipitation**

Precipitation in the Pacific Northwest is expected to increase but to remain within historical ranges for rainfall. Winter precipitation is projected to increase, while summers will be longer and even drier than at present. For the Coast Range and lower elevations, precipita-

tion will be mostly rain, as at present. Some research anticipates an increase in intense precipitation events.

Likely Effects on Oregon's Coastal Communities

Climate shapes communities in many ways; some obvious, others subtle. The economy and culture of coastal communities, for instance, are tightly linked to climate. Historic precipitation patterns and generally mild temperature support the timber, agricultural, and recreational economic sectors. The effects of climate changes can be generally described, even though their magnitude, timing, and location cannot be known for certain. Anticipating both gradual change and episodic events is essential to enable communities to become resilient to effects from climate change.

Community Infrastructure

Climate conditions are generally factored into the design of community infrastructure. As climate conditions change, some infrastructure systems may be less effective or may fail altogether, which could alter the function, value, or viability of improvements these systems protect or serve.

- **Transportation and navigation**

Coastal roads, highways, and rail lines are at risk from the effects of increased winter precipitation, increased coastal erosion, and flooding. Over the long term, roads, highways, and railroads will be affected by sea level rise and increased tidal elevations along the ocean shore, estuaries, and coastal rivers.

Airport runways such as those in North Bend and Astoria are located on filled estuarine wetlands and may be at risk of inundation from storm surge and high tides and, over time by sea level and increased tidal heights.

Port facilities, jetties and groins will be subject to damage from larger storm waves. Watershed flooding may increase sediment loads into estuaries and thus increase the need for dredging of navigational channels. Increased tidal height will affect docks and bulkheads.

- **Shore Protection and Flood Control Structures**

Dikes and levees: Extensive areas in Oregon’s estuaries are protected from tidal inundation by dikes and levees. Rising sea level and the increased likelihood of inundation from higher storm surge and tidal heights, especially in times of river flooding, may threaten the integrity of dikes and levees. Infrastructure and development on lands protected by dikes are at risk of damage and inundation as dikes fail.

Shore protection improvements: Some portions of Oregon’s ocean shorelines have been armored against erosion from ocean waves, primarily in front of properties developed before 1977. As shorelines erode landward in response to higher sea level and storms, armored properties are at risk of becoming peninsulas, then islands, and then overtopped. An increase in significant wave heights is likely to damage or cause failure of some hardened shorelines, potentially resulting in damage to nearby unprotected property and infrastructure.

- **Municipal Services**

Stormwater systems: The capacity of local stormwater management systems may be exceeded as the magnitude or frequency of rainfall events increases, especially as tidal elevations rise leading to localized flooding, accelerated deterioration, and possible system failure. Systems at or near capacity today may be unable to handle future storm loads, which could have a significant effect on location of future development.

Water supply and wastewater treatment: Rainfall in winter is projected to increase. However, storing water across longer, drier summers may be a problem for some coastal communities where storage systems are already at or over capacity during summer. Reduced precipitation in summer months, especially in conjunction with warmer winter temperatures, may reduce the water available for municipal supply systems. In addition, wastewater treatment facilities are usually located at the lowest elevation in a watershed, which places those facilities at risk from rising sea level and tidal elevation.

Recreational facilities: Increased erosion along Oregon’s ocean shore from rising sea levels and coastal storms may seriously alter beaches, and in some cases, the infrastructure necessary for safe access to and from beaches and coastal parks. Coastal forest trails and campgrounds may experience frequent damage from high winds and flooding.

Coastal Natural Systems

Many familiar coastal habitats, ecosystems, and natural resources will be affected by climate change. Low-lying habitats and ecosystems are especially vulnerable to floods, tides and ocean waves. Temperature and precipitation changes will affect the distribution and composition of forests, riparian areas, and other terrestrial habitats. Even rocky intertidal habitats are vulnerable to increased atmospheric and ocean temperatures.

- **Rivers and Streams**

Coastal rivers: Streams that drain the Coast Range will carry increased runoff from greater winter rainfall but will become drier in summer due to decreased rainfall. More severe rainfall events in these streams may increase the frequency and severity of flooding episodes. Warmer summer temperatures and lower summer stream flows may raise water temperatures to the detriment of salmon and other cold-water species.

Inland rivers: Snow melt runoff is a factor in four rivers that are important to the Oregon coast and coastal fisheries: the Columbia, Umpqua, Rogue, and Klamath. For these rivers, less snow fall and more rain may alter seasonal flow regimes, resulting in lower stream flows in late spring through the summer and fall. Changes in flow regimes may affect salmonids that are adapted to these stream systems. For the Columbia River, the presence of dams and a highly-engineered hydrologic system complicate projections of impacts of climate change on the river's natural resources and ecosystems.

- **Estuaries**

Estuaries are critical and unique habitats. Estuaries reflect a balance among competing natural forces. Sustained changes in sea level, tidal elevations, river flows, or sediment loads would necessarily alter the shape and productivity of Oregon's estuaries.

Estuarine wetlands are vulnerable to rising sea level and tidal elevations, depending on rate of sediment deposition, the nature of the shoreline, and pace of sea level rise. Freshwater tidal wetlands may be inundated more frequently by saline waters, triggering changes in wetland communities. Because most Oregon estuaries are sharply bounded by steep hillsides or dikes and levees, fringe wetlands will be unable to migrate landward and will be inundated due to increased tidal elevation. An adequate supply of sediments to the es-

tuary could enable tidal wetland elevations to keep pace with rising tidal elevation.

Estuarine benthic ecosystems: Higher air temperatures can heat mudflats and raise estuarine water temperatures, especially upstream of ocean influence, thus affecting benthic communities and productivity. The loss of benthic habitat will directly affect the composition and productivity of estuarine ecosystems.

Ocean spits: Rising sea levels and increased storminess will likely result in the long-term movement of the sand spits that form the outer boundary of many Oregon's estuaries. These forces could result in breaching of spits, as last occurred to the Tillamook spit in 1952, and which came close to occurring to the Netarts spit in 2007.

Invasive species: Estuaries in the Pacific Northwest have recently experienced biological invasions of non-native species that have had significant effects on estuarine communities. Such invasions may be related to climate factors.

Acidification: Oregon's estuaries are dominated by ocean water due to high tidal flushing twice daily. As ocean waters become more acidic, estuaries will be subjected to these same acidic conditions. The effects of increased acidity on estuarine ecosystems are not yet known, but scientists are concerned about the potential effects on clams, crabs, oysters and other shellfish.

- **The Pacific Ocean**

Ecosystem shifts: Summer winds are critical to upwelling that drives productivity of marine ecosystems. Recent El Niño events demonstrated that warmer ocean temperatures and shifting wind patterns can, from just one season to the next, affect upwelling and the production of phytoplankton, zooplankton, and forage fish. Seabirds, marine mammals, salmon and other species were adversely affected by El Niño conditions and are expected to be affected by long term shifts in climate conditions.

Distribution of species: Long-term changes in ocean conditions are likely to result in a northward shift in the distribution of marine species, including sea birds and marine mammals. El Niño conditions have been cited as a factor in marine mammal mortality, evidence of warm water fish in waters off Washington, and lack of seabird reproductive success.

Changes in upwelling: Timing of the seasonal upwelling in the Pacific off Oregon, which provides the nutritional foundation for the marine food web, is changing. A long-term shift in the timing of up-

welling would have long-lasting effects on Oregon’s commercial and recreational fisheries.

Hypoxia: While it is not clear that climate change is causing the hypoxic ‘dead zones’ in ocean waters off Oregon, the forces causing the hypoxia are all linked to, and affected by, climate change.

Ocean acidification: Increasing ocean acidification due to its absorption of CO₂ has the potential to reduce the ability of marine species to form shells, which in turn would have a dramatic effect on the entire marine food web. Shellfish such as clams, oysters, and crabs will be particularly sensitive to an increasingly acid environment.

- **Coastal shorelands**

Ocean shore: The ocean shore will certainly be altered in many places due to higher sea level, higher waves, more frequent and stronger storms, and possible shifts in predominant wind directions. Beach and bluff erosion will result in shoreline retreat. Ocean shores armored with rip-rap and seawalls will be increasingly at risk over time.

Estuarine shores: The shorelines of estuaries will change over time as increasing tidal elevations push the “normal” shoreline farther inland. Habitats and human uses in low-lying areas adjacent to estuaries are at risk over time even if protected by bulkheads, dikes, or levees. Habitat restoration projects in coastal shorelands should consider effects of future climate change.

- **Terrestrial and aquatic habitats**

Habitat distribution and composition: Terrestrial and aquatic habitats, which reflect a balance of many factors, will be affected by changes in climate. As the suitability of habitats declines, the ranges of species will likewise shift. Salmon populations, especially, are vulnerable to increased water temperatures and other climate variables throughout their life histories.

Non-native species: Habitat changes in response to shifts in temperature, salinity, and precipitation will provide opportunities for invasion by non-native species that are adapted to the new habitat conditions or that out-compete native species weakened by habitat change.

Coastal Economic Sectors

Most of the coast’s natural resource-based economic sectors are likely to be affected by changing conditions related to climate.

- **Ocean Fisheries**

Salmonids: Salmon, in particular, are highly vulnerable to changes in conditions throughout the many parts of coastal and ocean ecosystems that they occupy during their life. Expected climate-induced effects on watersheds, rivers, estuaries, and ocean ecosystems do not bode well for salmon, particularly in stream systems with already low populations.

Harvest effects: Some commercial ocean fish stock, already at low levels from overharvest, may be at risk over the long term as ocean conditions change. Changes in ocean ecosystem conditions are likely to fundamentally alter the historic fisheries of the Oregon coast.

Ocean acidification: Calcium-based plankton, which support the marine food web, are at risk from even minute changes in ocean acidity. Changes in plankton production will affect fisheries in ways that cannot now be predicted. It is not known how larger shellfish, such as clams, oysters, and crabs will fare in an increasingly acid environment.

- **Agriculture**

Water supplies: On the south coast, water supplies needed to harvest cranberry crops may be problematic. Overall, surface water supplies from rainfall are expected to increase due to winter rains.

Dikes, levees, and tidegates: Dikes, levees, and other structures that create and protect agricultural lands around Coos Bay, Young's River, Tillamook Bay, and other estuaries and tidally-influenced rivers will be subject to higher tidal elevations and riverine flooding as sea level rises. The condition of many of these structures is not known.

- **Forestry**

Forest mix: The mix of tree species in Oregon's Coast Range Mountains and coastal lowlands is likely to change in response to changes in temperature and precipitation regimes. Broadleaf species are projected to increase in conifer forests. Forest managers may need to adjust the composition of species to be planted after harvest. Insects and disease that respond to various climate conditions will affect forest composition.

Forest growth: Warmer temperatures, increased precipitation in winter, and higher levels of CO₂ in the atmosphere will likely stimulate forest growth.

Forest resilience: Forests in the Coast Range, unlike forests elsewhere in the U.S., are likely to be relatively resilient to the increased winter precipitation and longer, drier summers that are projected.

Fires: Despite hotter, drier, and longer summers and an increase in woody growth and insect outbreaks, the risk of forest fires in the Coast Range is projected to remain relatively stable because of increased wet conditions during winter.

- **Travel and hospitality**

The Oregon coast has long been an attractive destination for tourists and for those who enjoy its many outdoor recreational opportunities and resources. Businesses in these sectors may benefit from the effects of climate change on the Oregon coast.

Recreation: Longer, drier summers may benefit Oregon's coastal recreation industries by extending the recreation season and expanding options. However, parks and recreational facilities along the ocean shore and around estuaries are likely to be affected from increased winter storms, ocean flooding, and over time, sea level rise.

Tourism: The Oregon coast may realize expanded tourist visitation because of a relatively mild and dry summer climate and extended travel season. Compared to other parts of the country, the Oregon coast may be seen as very comfortable, whether in summer or in winter, and therefore very desirable.

- **Growth and development**

Climate conditions, even though changed from historic patterns, may be relatively attractive compared to other parts of the country and therefore may attract "climate-refugees" seeking more optimum climate conditions. Coastal communities could thus experience increased in-migration, particularly retired persons, which would increase demand for residential and commercial development and demands on public facilities.

Selected References

Fourth Assessment Report: Climate Change 2007. Intergovernmental Panel on Climate Change (IPCC), three volumes and synthesis report.
<http://www.ipcc.ch/ipccreports/assessments-reports.htm>

Potential Consequences of Climate Variability and Change for the Pacific Northwest. 2000. Chapter 9 of the US National Assessment of the Potential Consequences of Climate Variability and Change. 34 pp. <http://www.usgcrp.gov/usgcrp/nacc/pnw.htm>

Scenarios of future climate for the Pacific Northwest. 2008. Climate Impacts Group, Center for Science in the Earth System, Joint Institute for the Study of the Atmosphere and Ocean, University of Washington, Seattle. <http://cses.washington.edu/cig/fpt/ccscenarios.shtml>

Sea Level Rise in the Coastal Waters of Washington State. 2008. University of Washington Climate Impacts Group Seattle, WA.
<http://www.cses.washington.edu/db/pdf/moteetalslr579.pdf>

Scientific Consensus Statement on the Likely Impacts of Climate Change on the Pacific Northwest. 2004. Appendix C to the Oregon Strategy for Greenhouse Gas Reductions. Compiled for 2004 symposium on “Impacts of Climate Change on the Pacific Northwest.”
<http://www.oregon.gov/ENERGY/GBLWRM/docs/GWRReport-Final.pdf>

Final Report to the Governor: A Framework for Addressing Rapid Climate Change. 2008. The Governor’s Climate Change Integration Group. Oregon Department of Energy. Salem, OR.
<http://www.oregon.gov/ENERGY/GBLWRM/docs/CCIGReport08Web.pdf>

The Potential Consequences of Climate Variability and Change on Coastal Areas and Marine Resources 2000, Report of the Coastal Areas and Marine Resources Sector Team, U.S. National Assessment of the Potential Consequences of Climate Variability and Change, U.S. Global Change Research Program. NOAA Coastal Ocean Program Decision Analysis Series No. #21. NOAA Coastal Ocean Program, Silver Spring, MD.
<http://www.cop.noaa.gov/pubs/das/das21.pdf>

A Survey of Climate Change Adaptation Planning. 2007. The H. John Heinz III Center for Science, Economics and the Environment, Washington, D.C.
http://www.heinzctr.org/publications/PDF/Adaptation_Report_October_10_2007.pdf

Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments is a comprehensive guide prepared and published in 2007 by King County Washington and Climate Impacts Group at the University of Washington.
<http://cses.washington.edu/cig/fpt/guidebook.shtml>

This strategy and accompanying background study were prepared by the Oregon Coastal Management Program, Department of Land Conservation and Development; Jeff Weber, project manager and lead author; Bob Bailey, editor.

Our work benefitted greatly from consultation and advice from Joe Cone, Oregon Sea Grant; Mike Graybill, South Slough National Estuarine Research Reserve; Jonathan Allan, Oregon Department of Geology and Mineral Industries; Michael Harte, Oregon Sea Grant; and Lara Whitely Binder, University of Washington Climate Impacts Group.

<http://www.oregon.gov/LCD/OCMP/index.shtml>

January 2009

*Oregon Department of Land Conservation and Development
Richard Whitman, Director
635 Capitol St. NE #150
Salem, Oregon*



This document was produced with funding assistance from the Office of Ocean and Coastal Resources Management, National Oceanic and Atmospheric Administration, grant award NA08NOS4190422.

