
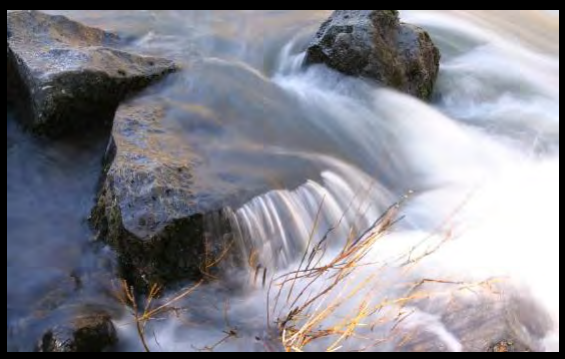



OREGON'S
INTEGRATED WATER RESOURCES STRATEGY






AUGUST 2012

State of Oregon
Oregon Water Resources Department
725 Summer Street NE, Suite A
Salem, Oregon 97301

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August 2012

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Cover Photos: Bob Wood, OWRD; Kyle Gorman, OWRD; Gary Halvorson, Oregon State Archives; and Rick Swart, ODFW

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OREGON WATER RESOURCES COMMISSION
Resolution Adopting the State's Integrated Water Resources Strategy

Whereas, although Oregon has a reputation as a wet state, it still faces challenges meeting its water quantity, water quality and ecosystem needs;

Whereas, these challenges will only increase in the future with projected changes in population, climate conditions, and land use;

Whereas, the Oregon Water Resources Commission took an early leadership role, calling for a statewide water strategy, crafting early drafts, providing suggestions on process and content, and keeping the issue at the forefront of every Commission meeting since 2007;

Whereas, the public process used to identify Oregon's critical water issues and potential solutions was inclusive, open, and transparent, with eleven open houses, multiple government-to-government meetings, dozens of stakeholder workshops, seven rounds of public comment, and continual opportunities for online, written and verbal input;

Whereas, the Project Team included the four state agencies responsible for the development of the Strategy—the Water Resources Department, the Department of Environmental Quality, the Department of Fish and Wildlife, and the Department of Agriculture;

Whereas, the development process depended greatly upon a Policy Advisory Group, comprised of 18 citizen members from across the state, representing diverse perspectives in the field of water;

Whereas, the development process benefitted from a State Agency Advisory Group and a Federal Liaison Group, comprised of 28 natural resource and economic development agency partners;

Whereas, the following boards, commissions, and agencies have provided letters in support of the Strategy and the importance of its role in Oregon's water future—the Board of Agriculture, Board of Forestry, Board of Geology, Drinking Water Advisory Committee of the Oregon Health Authority, Environmental Quality Commission, Fish and Wildlife Commission, Land Conservation and Development Commission, Parks and Recreation, State Marine Board, Sustainability Board, Watershed Enhancement Board, U.S. Bureau of Reclamation, U.S. Department of Energy's Bonneville Power Administration, U.S. Environmental Protection Agency, U.S. Geological Survey, and the U.S. Forest Service;

Whereas, Oregon's Integrated Water Resources Strategy includes Recommended Actions in thirteen water-related issue areas, designed to help the state understand and meet its instream and out-of-stream water needs;

Whereas, Oregon's first Integrated Water Resources Strategy has been completed on time, within budget, and according to the parameters set forth in ORS 536.220; Now, therefore,

Be It Resolved, we the undersigned members of Oregon's Water Resources Commission do hereby adopt Oregon's first Integrated Water Resources Strategy on this second day of August, 2012.

John E. Jackson, Chair
Northwest Region

Charles Barlow, Vice Chair
Eastern Region

Jeanne LeJeune
Westside at Large

Mary Meloy
North Central Region

John E. Roberts
Southwest Region

Carol A. Whipple
West Central Region

Ray L. Williams
Eastside at Large

JOHN A. KITZHABER, MD
Governor

Benjamin Franklin once said that when the well runs dry, we realize the value of water. The Integrated Water Resources Strategy is a long-overdue assessment that reflects how we value water here in the state of Oregon. Fortunately, our well hasn't run dry, and with this kind of strategic planning, it won't.

From my first legislative water committee, 25 years ago, I have recognized the importance of water in almost every aspect of our lives. There is increased pressure for this natural resource all over the world, and Oregon is certainly no exception. The state's first Integrated Water Resources Strategy is therefore an important achievement, given the importance of water to us all.

This document reflects Oregon's diverse opinions and interests, while providing a blueprint for opportunities both in-stream and out – from our agricultural sector to our municipal water supply to healthy fish and other aquatic life.

With a template for policy and investment strategies, we can move toward implementation, pursuing these ideas to ensure Oregon has the resources it needs to thrive and grow. I am committed to making this a reality, but implementation will rely on all of us working together. I hope that Oregonians continue to stay engaged to move this effort forward.

John A. Kitzhaber, M.D.
Governor

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Photo: Base Camp Baker

The fundamental purpose of this document is to understand Oregon's water needs and to articulate a strategy to meet those needs into the future. Although the Integrated Water Resources Strategy is ambitious (there are not currently enough resources to fully implement all of the actions listed here), the intent of the Strategy is to provide a blueprint for future actions.

Water is one of the world's most precious natural resources. With more than 100,000 miles of rivers and streams, 360 miles of coastline, and more than 1,400 named lakes, Oregon is renowned for its water. Our rivers, streams, lakes, wetlands, springs, and aquifers provide a wide range of benefits to all Oregonians.

This clean and reliable source of water is essential for meeting our basic human needs, and for supporting Oregon's economy—the thousands of businesses and industries that rely upon water in some form, to irrigate a crop, to manufacture a product, or to provide a service or experience.

Oregon's economy, in turn, is dependent upon a healthy environment where water resources play an essential part. Fish and wildlife need a sufficient quantity and quality of water—from the rivers, lakes, wetlands, and estuaries—to live, reproduce, and thrive. A healthy evironment includes fully functioning ecosystems that are able to support our commercial and recreational needs and a quality of life unique to Oregon and the Pacific Northwest.

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Building a Water Strategy for Oregon

In order to achieve Oregon's vision for water, a strategy was developed that brings various sectors and interests together to work toward the common purpose of maintaining healthy water resources to meet the needs of Oregonians and Oregon's environment for generations to come.

With leadership, support, and direction from the State Legislature and the Water Resources Commission, Oregon's natural resource agencies set out to develop a statewide, integrated water resources strategy to meet current and future water needs.

Unlike traditional water supply plans, this Strategy considers instream needs (where water remains in the environment) along with out-of-stream needs (where water is diverted for use), including water quality, water quantity, and ecosystem needs.

The Oregon Water Resources Department, the state agency responsible for water quantity, took the lead to develop this Strategy. The Department worked closely with the Oregon Department of Environmental Quality and the Oregon Department of Fish and Wildlife to ensure that water quality needs and ecological needs were directly addressed. The Oregon Department of Agriculture, which oversees the safety and promotion of Oregon agriculture, also played an important role in the development of the Integrated Water Resources Strategy.

A "Bottom-Up" Approach

Oregon's first integrated water resources strategy, although led by state agencies, was built from the ground up. Early on, the four state agencies actively sought input from the public, hosting discussions in eleven Oregon communities all across the state. Stakeholders and several water-related organizations also participated in individual workshop discussions.

The public input gathered from these discussions resulted in an extensive list of water-related challenges that Oregonians care passionately about and want to see addressed in the state's first water strategy. From the very beginning, Oregonians offered a variety of solutions and ways the State could move forward to improve water resources management in Oregon.

Conversations continued with formal advisory groups that offered advice on the most critical issues to address and the most promising solutions.

More than fifteen natural resource and economic development state agencies and ten federal agencies with diverse responsibilities in the areas of water supply, water quality, land management, and fish and wildlife management in Oregon, provided assistance and feedback during development of the Strategy. These agencies were instrumental in helping to identify the successful tools, plans, and programs already in place today that can be built upon or further integrated under the umbrella of the Integrated Water Resources Strategy.

In any public outreach effort, it is very challenging to reach every citizen of the state. An 18-member advisory group of citizens and stakeholders was formed to help achieve a diverse range of perspectives and interests, and to help speak on behalf of all Oregonians. Like the state and federal agencies, their feedback and recommendations were invaluable for developing the structure and content of the Strategy.

The comments, feedback and input received throughout the development of the Strategy were shared regularly with the Water Resources Commission, other boards and commissions, the Oregon State Legislature, and the Governor's Office.

After more than three years of engagement with Oregon's citizens, the Water Resources Commission formally adopted Oregon's first Integrated Water Resources Strategy the second day of August 2012, with implementation beginning immediately.

Founded in Law

Successful long-term investment in Oregon's economy and environment requires a foundation of certainty and law, and this Strategy upholds the rule of law and the long-standing history that supports it.

This Strategy places an emphasis on collaboration and voluntary efforts. It identifies areas where incentives, whether financial, technical, or policy in nature, could serve as powerful tools for progress. It also identifies where public and private partnerships could stretch our dollars and further our instream and out-of-stream goals. Just as importantly, the Strategy is ***not*** intended to remove or jeopardize existing water rights or other local, state, and federal authorizations. The Strategy does not relinquish any existing authorities.

Finding Your Way Around the Document

This document is organized in a way that supports the authorizing language of HB 3369 (now ORS 536.220). In its deliberations over House Bill 3369 in 2009, Oregon's Legislature posed two questions essential to Oregon's future: what is the current state of Oregon's water supply relative to its needs, and what must Oregon do to ensure that sustainable supplies of clean and abundant water are available to meet future instream and out-of-stream needs?

Organization

Recommended actions described in each section focus on improving, modernizing, and expanding Oregon's foundation of data and programs. The conclusion presents a long-term blueprint—an overview of "next steps"—for the State of Oregon to follow in order to understand and meet its water needs. The conclusion is presented in the context of efforts already underway, as well as additional work needed in short-term (the next five years) and the long-term.

The Strategy is organized around four main objectives, which are presented as chapters, and within each chapter, sections highlight the critical issues and recommended actions needed to address those issues.

Cross-Cutting Issues

Four cross-cutting issues are of vital importance to Oregon's water future: groundwater, climate change, funding, and institutional coordination. These four issues are present or implied in every section of this Strategy. An overview of each follows.

Groundwater: Oregon monitors and manages groundwater at the state level (unlike several other western states). This approach enables the State to track groundwater availability and groundwater quality, manage surface water and groundwater conjunctively, make science-based permitting decisions, and to provide information to local planners and other decision-makers. Unfortunately, groundwater science, so critical to economic and environmental decision-making, has been given short shrift in public and private

budgets during recent decades, causing significant knowledge gaps at local, state, and federal levels. Major groundwater-related items are found in several of the recommended actions.

Climate Change: The authorizing language of ORS 536.220 highlights climate change in several instances. It calls for recommendations regarding continuous monitoring of climate change effects on Oregon's water supply, and for recommendations regarding the water user actions that are necessary to address climate change. Climate change actions will draw upon a suite of tools and approaches, including increasing water conservation and efficiency efforts, expanding natural and built storage, and strengthening the resiliency of riparian areas, forest lands, wetlands, and floodplains.

Adaptation to climate change requires a closer look at how it may affect water rights, crop production, and migration patterns. You can find several recommended actions that relate to climate change throughout the document.

Funding: Much of the content in this Strategy focuses on policy and administration, however, implementation cannot occur without investing the time, energy, and expertise in these areas. Today, the agencies that protect and manage Oregon's natural resources receive less than one-percent of the General Fund. Water managment receives an even thinner slice of that investment.

An analysis of budgets in other western states reveals millions—if not billions—of dollars dedicated to the development and protection of water resources. These are orders of magnitude beyond what Oregon historically has spent in support of its most precious natural resource. The Strategy specifically focuses on funding for work at the state and local level, but all of the recommended actions contain a funding component.

Institutional Coordination: No entity is an island when it comes to water management. In Oregon, all water is publicly owned, and there are a multitude of public and private organizations with specific responsibilities and authorities related to the management of Oregon's water resources.

These organizations reside at the local, state, tribal, and federal level and each has a different mandate, funding base, and constituency. There are many ways these organizations can more efficiently communicate, pay for, and implement their planning and policy development, from data collection to project implementation. You can find recommended actions focused on institutional collaboration and coordination throughout the Integrated Water Resources Strategy.

Oregon's Water Strategy for the Future: Four Primary Objectives

Oregon's Integrated Water Resources Strategy provides a blueprint to help the state better understand and meet its instream and out-of-stream water needs, taking into account water quantity, water quality, and ecosystem needs. It consists of four primary objectives, followed by critical issues with more detail, and thirteen sets of recommended actions.

The Four Primary Objectives:

OBJECTIVE 1
Understand Oregon's Water Resources Today

Oregon needs to fill the knowledge gap—gathering, processing, and sharing water resources information, so that the State can better characterize its water resources to sustain Oregon's jobs and the economy, as well as a healthy environment.

OBJECTIVE 2
Understand Instream and Out-of-Stream Needs

Oregon needs a better grasp of current and future needs—both instream and out-of-stream. Without a better characterization of current water use and future water quantity, water quality, and ecosystem needs, the State cannot adequately plan to meet these needs into the future.

OBJECTIVE 3
Understand the Coming Pressures that Affect Our Needs and Supplies

Oregon must anticipate and model some of the most powerful changes that may affect both water resources and water needs into the future. Such changes include climate change, population growth and shifts, economic development, changes in land use, infrastructure needs, the water-energy nexus, and the need for water-related education.

OBJECTIVE 4
Meet Oregon's Instream and Out-of-Stream Needs

Oregon needs to integrate and coordinate both the long-term planning and day-to-day management of Oregon's water resources among local, state, federal, and tribal governments, as well as with other state partners. Key actions here include state-level and place-based planning, water management and development, protection of public health and ecological health, and stable funding.

CHAPTER 1

UNDERSTAND WATER RESOURCES TODAY

Crooked River near Prineville, Crook County

Photo: Rich Marvin, OWRD

Limited Water Supplies & Systems

Water Management Institutions

Water Quality & Water Quantity Information

Oregon needs to fill the knowledge gap—gathering, processing and sharing water resources information, so that the State can better characterize its water resources for economic development and a healthy environment. This includes taking a look at the interaction between groundwater and surface water, and furthering our understanding of the limits of our water supplies and systems.

Because water is managed for a variety of beneficial uses, there are many entities involved at all levels of government, with different management responsibilities. Improving our understanding of Oregon's major water-related institutions and documenting their role in water resources management can help us further integrate and coordinate information and improve decision-making.

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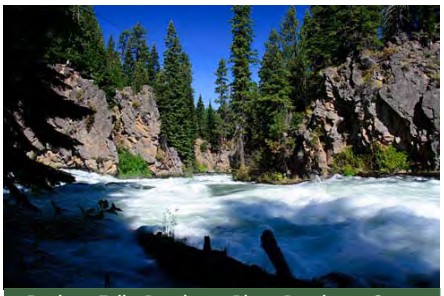
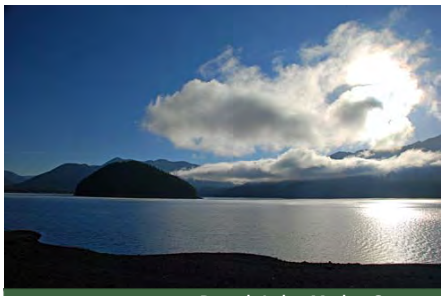
Owyhee River at Leslie Gulch, Malheur County


Benham Falls, Deschutes River, Deschutes County


Detroit Lake, Marion County

Photos: Gary Halvorson, Oregon State Archives

Water is Oregon's most precious natural resource. In an average year, Oregon can expect to see an estimated 100 million acre-feet of water fill our lakes and streams and recharge our groundwater aquifers. This amount does not include water that evaporates from plants or from the land's surface or water that originates outside of the boundary of our state.

Oregon's rivers, streams, lakes, estuaries, wetlands, springs, and aquifers support a wide range of benefits for both humans and the environment—sources of water for drinking, agriculture, industry, and recreation and sources of essential habitat for fish and wildlife.

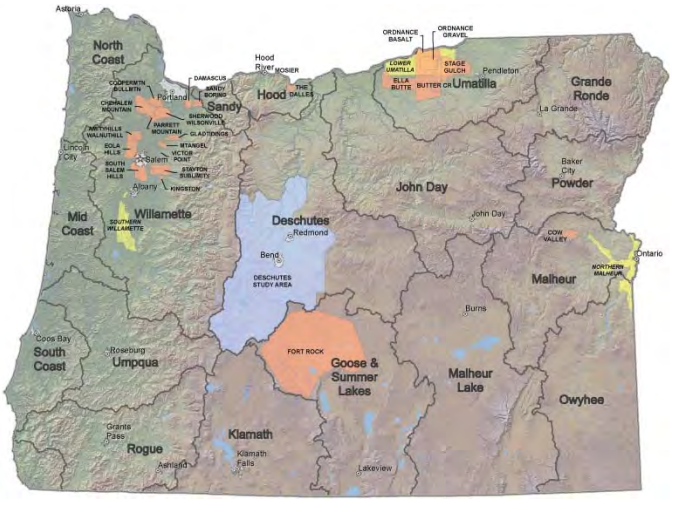
The Status of Oregon's Water Resources

Groundwater

Groundwater occurs almost everywhere beneath the land surface. Because of its connection to surface water, it is a major contributing source of water for many springs, lakes, and wetlands in Oregon. Groundwater feeds streams and rivers gradually throughout the year, and augments streamflow in late summer months.

Under much of the land surface in northern Oregon is a series of very thick, ancient lava flows called the Columbia River Basalt Group. These layers contain an extensive system of aquifers that can be used to store and retrieve water. In other parts of Oregon, underlying volcanic rocks, gravel, and sand may also be suitable for aquifer storage. Although groundwater occurs almost everywhere, availability of groundwater for large-scale use and development varies widely, depending on geologic conditions, climate, how groundwater interacts with surface water, and the extent of previous development pressures on the resource.

During the past 60 years, groundwater development has occurred primarily in areas where the geologic conditions are favorable or where additional surface water is no longer available. In some locations throughout the state, groundwater aquifers are no longer capable of sustaining additional development. In the Willamette Valley, for example, twelve areas have been completely withdrawn from future uses or limited to some uses, allowing only minimal irrigation or essential public safety needs, such as fire protection.



The limitations of groundwater extend beyond quantity. Some aquifers contain saline water. Others contain area-wide nitrate contamination. Groundwater contamination is a serious issue in some locations throughout Oregon, affecting portions of Linn, Lane, and Benton Counties, the Lower Umatilla Basin, and northern portions of Malheur County.

Surface Water and Groundwater Interactions

Surface water interacts with groundwater in three basic ways: 1) streams gain water from inflow of groundwater via springs or seepage through the streambed; 2) streams lose water to groundwater by outflow through the streambed; or 3) they do both, gaining in some reaches and losing in others.

Gaining streams represent locations where cooler groundwater emerges and contributes to a stable base flow, helping to sustain surface water during the summer months, and providing prime spawning conditions. Losing streams can act as a potential route of groundwater contamination, as polluted runoff enters streams that eventually percolate back into the ground.

In many parts of Oregon, groundwater interacts directly with surface water. Oregon water law recognizes this important connection as a fundamental aspect of the State's water code, and the State manages groundwater-surface water sources as one, where appropriate. This is called conjunctive management.

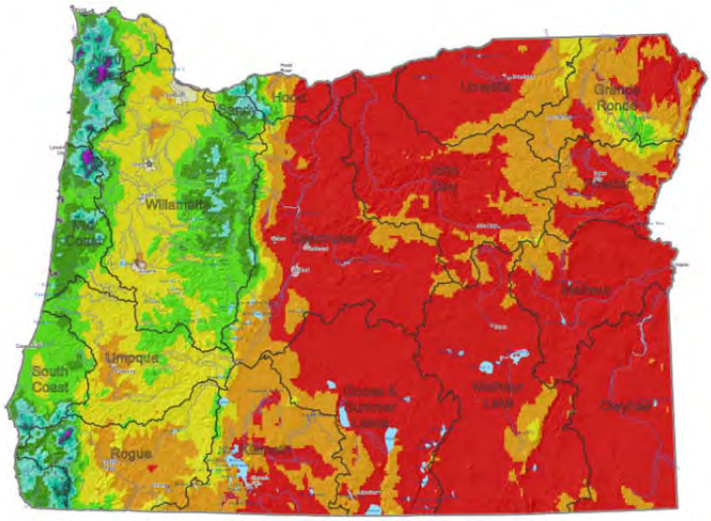
Generally, the Water Resources Department denies or limits groundwater applications in instances where use from a groundwater aquifer can substantially interfere with a surface water source that is already fully appropriated. One example of conjunctive management stems from a 2001 study conducted by the Water Resources Department and U.S. Geological Survey that identified a hydraulic connection between groundwater and surface water within the Deschutes Groundwater Study Area. Because of this connection, new groundwater withdrawals must now be mitigated with a similar amount of water placed instream, to offset the impact to surface water flows.

Precipitation

The availability of surface water depends greatly on the location and timing of precipitation.

Although the average annual precipitation for the entire state is about 30 inches, it is not distributed evenly across the state. Precipitation varies widely throughout Oregon, depending on location—from as much as 200 inches per year at points along the coastal mountains to less than 8 inches in areas of drier eastern Oregon. This disparity means that some Oregon communities often experience flooding conditions while others experience drought.

The abundance of precipitation on the west side of the state during the winter months contributes to Oregon's reputation as a wet state.



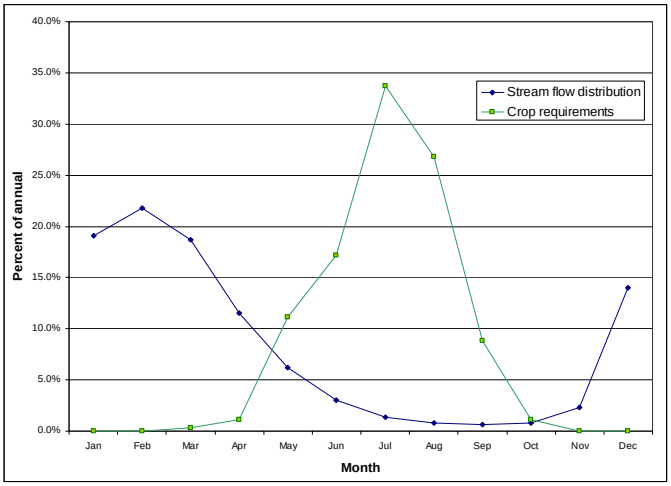
Average Annual Precipitation in Oregon

Timing—Supply versus Demand

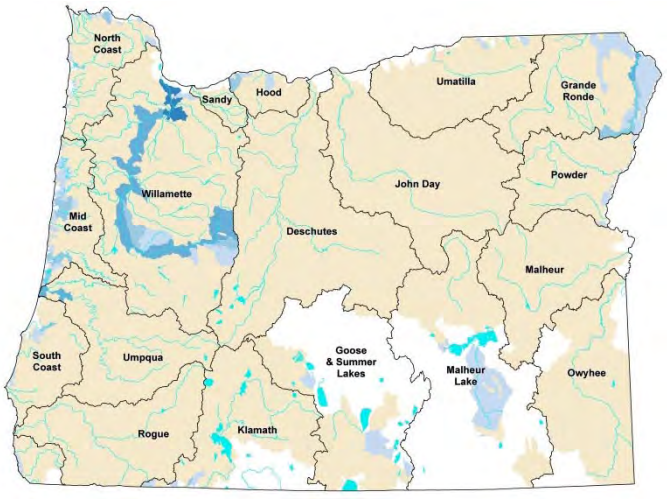
The arrival of precipitation in Oregon, whether by rain or snow, typically occurs between the months of October and May. This stands in stark contrast to the months in which water demands are at their peak for most uses.

The accompanying graph demonstrates this mismatch in timing. The green line represents crop requirements that peak in demand during the months of June, July, and August. The blue line in the illustration represents typical stream flow distribution in western Oregon, hitting a trough during those same summer months.

Instream needs are more difficult to place on a graph, as different species require streamflow at different times of the year for different biological purposes. Generally, in terms of timing, low streamflows during the summer months represent the greatest concern for meeting instream needs.



Typical Timing of Streamflow vs. Demand in Oregon



August Available Streamflow

Streamflow estimated at 80% Exceedance

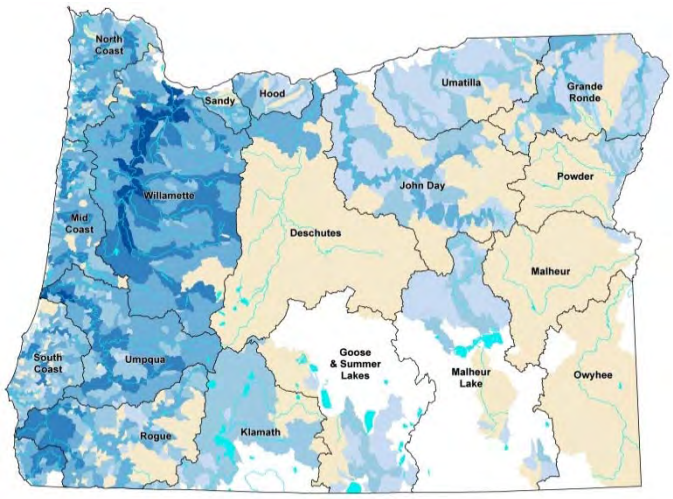
- No data
- No water available
- 0.1 – 10 cfs
- 10.1 – 100 cfs
- 100.1 – 1,000 cfs
- 1,000.1 – 10,000 cfs
- 10,000.1 cfs or greater

Water Availability

Most of the surface water resources in Oregon are fully allocated during the summer months.

The Oregon Water Resources Department has created and continues to maintain a database of the amount of surface water available for appropriation for most waters in the state. This database is used to evaluate applications for new uses of water.

The accompanying map shows (in blue) where water is available for live flow allocation during the month of August, the month most representative of low summer flows and high out-of-stream demands. With some exceptions, the mostly-tan map indicates that throughout the state, very little surface water is available to allocate for new uses during August.



January Available Streamflow
Streamflow estimated at 50% Exceedance

- No data
- No water available
- 0.1 – 10 cfs
- 10.1 – 100 cfs
- 100.1 – 1,000 cfs
- 1,000.1 – 10,000 cfs
- 10,000.1 cfs or greater

However, some water is available during the winter months to allocate for new instream or out-of-stream uses. This map illustrates water availability during the month of January.

Increasingly, water users are relying on tools such as water conservation, re-use, transferring existing water rights, and water storage to meet their needs during the summer months. Many water users store available winter water (surface water) to supply late season or year-round uses.

How We Use Water

Water users in Oregon divert about 9 million acre-feet of water each year for out-of-stream uses. This represents approximately eight percent of the estimated annual yield. These diversions serve four primary types of user groups: agriculture, municipalities, self-supplied industry, and domestic users. Further discussion of out-of-stream uses begins on page 29.

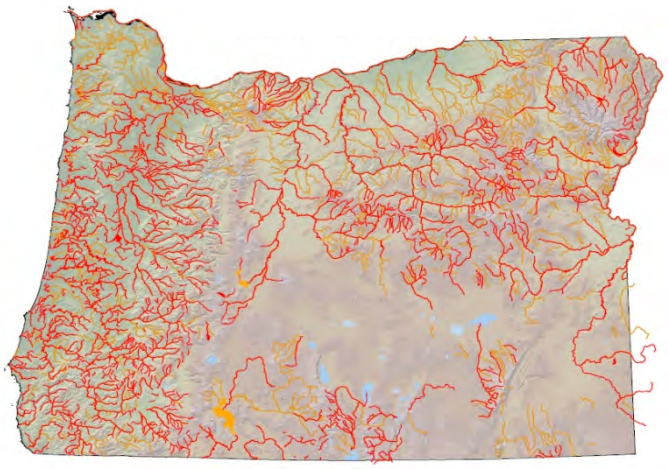
The water that is not diverted totals about 91 million acre-feet. A portion of this water, approximately 19 million acre-feet, is protected by 1,400 instream water rights held in trust by the State. The water that stays instream and in the ground sustains aquatic species and ecosystems. Instream flows also support Oregon industries such as fishing, recreation, energy production, and transportation. Further discussion of instream needs begins on page 36.

Water Quality

Temperature, sedimentation, and nutrients are the leading pollutants that impair Oregon's rivers and streams. Impaired water quality drives up the cost of water treatment and limits access to clean water for fish, drinking water, agriculture and recreation.

More than 1,861 water bodies are impaired and not meeting water quality standards, including more than 30 lakes and reservoirs, and about 22,000 stream miles. The accompanying map shows impaired waterbodies throughout the state, where some locations still need a Total Maximum Daily Load plan (TMDL) for one or more pollutants, and others do not.

A TMDL is the calculated pollutant amount that a waterbody can receive and still meet Oregon water quality standards. Note that waters on this map are depicted as needing a TMDL (in red) until TMDL's have been completed addressing <u>all</u> impairing pollutants. Some waterbodies need more than one TMDL.



Oregon's Impaired Waters (2004/2006)

Impaired by one or more pollutants
(Needs TMDL 303(d) List)
Total – 1, 117 streams, lakes and reservoirs
14,905 miles
31 lakes and reservoirs; 46,753 acres

Impaired – does not need TMDL
(TMDL approved or impaired by non-pollutant)
Total – 1,231 streams, lakes, and reservoirs
16,736 miles
21 lakes and reservoirs; 96,799 acres

Note: This map shows all waters impaired by one or more pollutants in Oregon. Stream miles are not additive. Waters are depicted as needing a TMDL until TMDL's have been completed addressing all impairing pollutants.

Water temperature, which can increase as a result of low streamflow, loss of riparian vegetation, channel modification, or warm discharge, is a critical water quality parameter because it directly affects the survival of sensitive species such as salmon and trout. For lakes, ponds, and reservoirs, dissolved oxygen and habitat alteration are the two most common water quality issues.

Groundwater contamination is also a serious issue in some areas of Oregon. Ambient groundwater quality studies over the past 20 years and routine monitoring of public water supplies found that 35 of 45 study areas show some impairment or reason for concern. Nitrate is the most commonly detected contaminant in groundwater, followed by pesticides, volatile organic compounds, and bacteria. The State has conducted limited groundwater quality studies. With additional resources, it could evaluate additional areas for contaminants.

Impaired Water Quality and Ecosystem Conditions

Many species depend on Oregon's water resources. One way of tracking the status of both water quality and ecosystem health is through the use of a designated indicator species. The health of an indicator species, like the proverbial "canary in the coal mine," can be an indicator of overall ecosystem health and can offer early signs of stress, such as disease or pollution.

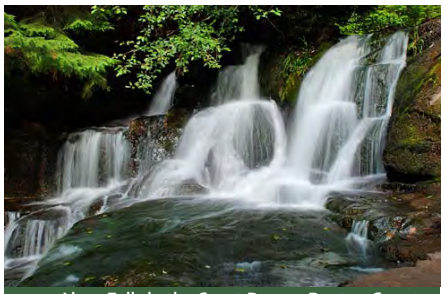
The most visible indicator species are native salmonids (salmon, steelhead, and trout) that depend on cold, clean water. Since 1991, NOAA Fisheries' Office of Protected Resources has listed 27 Pacific salmonid species under the Endangered Species Act (ESA), and has delisted zero species.

Many populations of Chinook salmon, coho, chum, and steelhead are at a fraction of their historic levels and are listed as threatened or endangered. In 2005, the Oregon Department of Fish and Wildlife published a Native Fish Status Report, noting that of 69 "Species Management Units," a population count of Oregon native fish species, 35 units were "at risk" and 9 were already extinct.

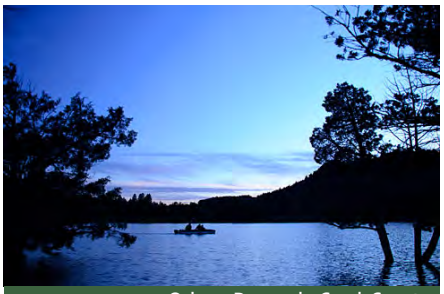
This document further examines the relationship between water and ecosystem health in sections related to instream needs, climate change, land use planning, healthy ecosystems, and public health.

CRITICAL ISSUE: FURTHER UNDERSTAND OUR WATER MANAGEMENT INSTITUTIONS

Columbia River, Umatilla County



Alsea Falls in the Coast Range, Benton County



Ochoco Reservoir, Crook County

Photos: Gary Halvorson, Oregon State Archives

This Integrated Water Resources Strategy recognizes the importance of Oregon's legal, scientific, and institutional foundation and commits to continuing and strengthening it. Oregon has often set the standard among states in water resources policy and implementation. Many of the laws noted in the timeline on the following pages represent "the first in the nation" and have served as a strong foundation for economic development, environmental restoration, and protection of human health in Oregon. This section provides an overview of Oregon's solid history in water resources management.

Timeline of Oregon's Leadership Role in Water Resource Management

- 1889--- Oregon enacts a state law prohibiting pollution of waters used for domestic or livestock purposes.
- 1898--- Oregon's first fish screening law passed, to protect fish from injury or mortality in diversion ditches, machinery, or irrigated fields.
- 1909--- Oregon Water Code creates a rational system of water allocation and distribution throughout the state.
- 1955--- Oregon Ground Water Act authorizes the state's management of groundwater resources.
- 1964--- Columbia River Treaty between the United States and Canada brings significant flood control and power generation benefits to both countries.
- 1967--- Oregon's Beach Bill gives the public free and uninterrupted use of the beaches along the Oregon Coast.
- 1970--- Oregon Scenic Waterways Act maintains the free-flowing character of designated rivers and lakes in quantities necessary to support recreation, fish, and wildlife uses.
- 1971--- Oregon Forest Practices Act regulates commercial forest operations on non-federal forestlands, including management of soil, air, water, fish, and wildlife resources.
- 1972--- Federal Clean Water Act regulates the water quality of streams, lakes, rivers, and estuaries.
- 1972--- Federal Safe Drinking Water Act (amended in 1996) regulates the quality of drinking water delivered through community water systems.
- 1973--- Federal Endangered Species Act makes all species of plants and animals, except pest insects, eligible for listing as endangered or extinct.
- 1973--- Oregon Land Use Act requires all cities and counties to develop comprehensive plans to address land-use problems and concerns.
- 1987--- Oregon Instream Water Rights Act recognizes water instream as a beneficial use and authorizes instream water rights.
- 1989--- Oregon Groundwater Quality Protection Act is passed to conserve, restore, and maintain the high quality of Oregon's groundwater.

Timeline, continued…

- 1989--- Oregon's "No Net Loss" Wetlands Policy is designed to maintain the acreage, functions, and values of the state's wetlands.
- 1989--- A Water Allocation Policy ensures that waters of the state are allocated within the capacity of the resource and protected from over allocation.
- 1993--- The Oregon Agricultural Water Quality Management Act provides a mechanism for agricultural operations to address water quality problems in watersheds.
- 1997--- The Oregon Plan for Salmon and Watersheds helps restore healthy watersheds that support the economy and quality of life in Oregon.
- 2000--- The Water Resources Commission adopts a Water Measurement Strategy, focusing on diversions with the greatest impact on streamflows in areas with the greatest fish needs.
- 2001--- Oregon's State Tribal Government-to-Government Law passed, directing state agencies to take tribal interests into account when developing policies or implementing programs that affect Tribal interests.
- 2006--- The Oregon Conservation Strategy provides a blueprint and action plan for the long-term conservation of Oregon's native fish and wildlife and their habitats.
- 2007--- Oregon Legislature establishes an Environmental Justice Task Force, calling for a greater voice and protection for underrepresented groups in agency decisions.
- 2009--- Oregon Legislature commissions an Integrated Water Resources Strategy to understand and meet Oregon's instream and out-of-stream water needs.
- 2009--- Oregon Legislature establishes an Ecosystem Services Policy, focusing on the protection of land, water, air, soil, and native flora and fauna.
- 2010--- Oregon Fish Consumption Rate revises human health criteria based on a per capita fish consumption rate of 175 grams/day—the most protective human health criteria in the nation.
- 2012--- Oregon launches a 10-year Energy Strategy, with potentially significant water implications, as it is designed to lower greenhouse gases, while increasing energy security and Oregon jobs.
- 2012--- Oregon Legislature requires a 10-Year Economic Development Strategy, with potentially significant water implications, as it is designed to encourage investment in and availability of capital to Oregon businesses.

In addition, Oregon is a national leader in many of the techniques and technologies used to manage water, including conjunctive management of groundwater and surface water, underground water storage, riparian restoration and protection, water efficiency techniques, remote sensing, and other technologies. Look for guest essays throughout this document, describing the use of these techniques and technologies in more detail. Opinions expressed in these essays belong solely to the authors.

Understanding How Water Quantity is Managed

Doctrine of Prior Appropriation

Under Oregon law, all water is publicly owned. Cities, farmers, factory owners and other users must obtain a permit from the Water Resources Department to use water from any source. Landowners with water flowing past, through, or under their property generally do not automatically have the right to use that water without authorization from the Department, although some uses are exempt.

Since 1909, Oregon's Water Code has created a rational system of water allocation and distribution throughout the state. Oregon's water laws are based on the principle of prior appropriation, meaning that the first person to obtain a water right on a stream is the last to be shut off in times of shortage.

Permits

In 1989, the Water Resources Commission directed the Water Resources Department to develop an allocation policy and establish a water availability program. The resulting tool, based on a historic hydrologic record, helps to evaluate whether new surface water proposals would be able to utilize surface water at least 80 percent of the time, or eight out of every ten years.

The amount of water available for new uses is affected by hydrologic conditions and existing uses of water, including groundwater uses that can interfere with surface water. When Oregon evaluates new requests for out-of-stream uses, it accounts for the needs of existing users, including established instream protections.

The Water Resources Department administers more than 80,000 water rights for both instream and out-of-stream uses, and on a daily basis it evaluates applications for new uses and changes to existing rights. Unlike several state agencies in Oregon, there is no federal agency that oversees the functions performed by the Water Resources Department.

Understanding How Water Quality is Protected

The Clean Water Act

The primary regulatory tool used to reduce or prevent pollutants from entering waterways is the Federal Clean Water Act. The Clean Water Act requires states to establish clean water standards to protect all beneficial uses of water (e.g., fishing, swimming, aquatic life, stock water, wildlife, mining, pollution abatement, power development, recreation, municipal, agricultural, and industrial uses). Tribes also have authority under the Clean Water Act to adopt and implement clean water standards on reservations. In Oregon, the Department of Environmental Quality (DEQ) administers the Clean Water Act, with oversight from its federal counterpart, the U.S. Environmental Protection Agency.

According to the Clean Water Act, each state must develop TMDLs for all the waters on the 303(d) list. One of the first steps for improving water quality after a TMDL is completed is to develop an implementation plan. Certain federal, state, and local governments and agencies, including cities, counties, and special districts become Designated Management Agencies because these agencies and governments have authority to manage and regulate sources of pollutants that are listed in the TMDL.

Permits

Oregon DEQ also issues National Pollutant Discharge Elimination System (NPDES) permits to regulate discharges of treated wastewater from industrial processes and sewage treatment plants. These permits limit the amount of pollution that can be discharged and require that specific practices be followed to protect the environment. Permitees are required to monitor discharges and report monitoring results to

DEQ, which then reviews these monitoring reports and conducts site inspections to ensure that permitees comply with the requirements.

Other Relevant Water Quality Laws

Both Oregon's Agricultural Water Quality Management Act (administered by the Oregon Department of Agriculture) and the Oregon Forest Practices Act (administered by the Oregon Department of Forestry) significantly contribute to the state's water quality protection efforts. Oregon relies upon the Groundwater Quality Protection Act of 1989 to prevent contamination of groundwater resources, to conserve and restore this resource, and to maintain the high quality of Oregon's groundwater resources for present and future uses. This Act established a policy that all state agencies' rules and programs are to be consistent with the goal of protecting drinking water resources and public health. The DEQ has primary responsibility for implementing groundwater protection in Oregon and uses a combination of water quality and land use programs to implement the Act.

Understanding How Ecosystems Are Protected

The Endangered Species Act (ESA)

The purpose of the Federal Endangered Species Act is to protect and recover imperiled species and the ecosystems upon which they depend. Under the ESA, species may be listed as either endangered or threatened. "Endangered" means a species is in danger of extinction throughout all or a significant portion of its range. "Threatened" means a species is likely to become endangered within the foreseeable future.

This law is administered by the U.S. Fish and Wildlife Service and the U.S. Commerce Department's National Marine Fisheries Service. The U.S. Fish and Wildlife Service has primary responsibility for terrestrial and freshwater organisms. The National Marine Fisheries Service has responsibility for marine wildlife such as whales and anadromous fish such as salmon.

The State is developing plans for 26 ESA-listed fish species in Oregon. Developed and implemented by the Oregon Department of Fish and Wildlife, these plans are designed to address legal requirements for recovery planning under the Endangered Species Act and under Oregon's Native Fish Conservation Policy. Such plans provide an informed, strategic approach to recovery that is based on science, is supported by stakeholders, and is built on existing efforts and newly proposed recovery actions. They allow for adaptive management over time as new information is acquired. Coordination of actions with other state and federal agencies, local governments, and citizens is essential for successful implementation.

Other Relevant Ecosystem Laws

Oregon established its first fish screening laws more than 100 years ago. Providing fish passage over man-made dams and diversions has also been a requirement since before statehood. Today, the State may require fish screens, passage, or bypass devices as a condition of new uses (permits) or authorized changes to an existing water right (transfers). The Oregon Department of Fish and Wildlife oversees the state's fish screening and fish passage programs.

Although Oregon's wetland management and protection programs date back to the early 1970s, legislation passed in 1989 adopted clear policies directed at maintaining the acreage, functions, and values of the state's wetlands. Oregon has adopted goals of *no net loss* of freshwater wetlands (administered by the Department of State Lands), and a *net gain* of estuarine wetlands (administered by the Department of Land Conservation and Development).

Understanding How Instream Flows Are Protected

Protecting streamflow and lake levels needed to support public uses is a high priority for Oregon, particularly for rivers, streams, and lakes that provide significant public benefits.

Oregon's Scenic Waterway Act

Oregon's Scenic Waterway Act has created one of the most extensive scenic waterway systems in the country, with more than 1,100 river miles protected for the beneficial uses of recreation, fish, and wildlife. The Act was passed in 1970 to maintain the free-flowing character of designated rivers and lakes in quantities necessary to support recreation, fish, and wildlife uses.

It specifically prohibits construction of dams or other impoundments within a scenic waterway. It limits new surface water rights within or above scenic waterways. It also limits new groundwater rights without mitigation, if groundwater pumping (individually or cumulatively) will measurably reduce surface water flows. Land use activities that can affect a scenic waterway or adjacent land (such as constructing roads or buildings, mining, and forest harvesting) are limited or regulated by this Act. The Oregon Parks and Recreation Department has primary responsibility for implementing the Scenic Waterways Act and coordinates with several natural resource agencies.

Oregon's Instream Water Rights Act

Oregon's Instream Water Rights Act was designed to protect instream flows by establishing instream water rights. Since the Act was passed in 1987, the Water Resources Department has approved more than 900 state agency-applied water rights to protect water instream for fish use, pollution abatement, and recreational purposes.

The Department of Environmental Quality, Department of Fish and Wildlife, and the Parks and Recreation Department can submit applications to protect water instream. These instream rights are then held in trust on behalf of the public by the Water Resources Department. These rights are usually set for a certain stream reach or at a specific point on the stream. Instream water rights have an established priority date, which means they can be regulated in the same way as other out-of-stream water rights. Agencies filed the majority of these instream water rights in the early-to-mid 1990s, which makes them junior to most out-of-stream uses. There are also more than 500 minimum perennial streamflows that must be maintained to protect and support aquatic life and to minimize pollution. Many of these were established during the 1950s and most have been converted to instream water rights.

Understanding How Public Health Is Protected

The Safe Drinking Water Act

The Federal Safe Drinking Water Act, combined with the Clean Water Act, provides a powerful set of tools for states to protect public health related to water. The 1996 Amendments to the Act created a coordinated set of programs and requirements to help water systems make sure they have a safe supply of drinking water.

Important elements of providing safe drinking water include: 1) protecting water sources from contamination, 2) treatment, monitoring and compliance, and 3) having informed and involved customers.

Public water systems, with state oversight, are important protectors of public health. Using a variety of treatments, these systems disinfect, filter, and control pathogenic organisms, harmful contaminants, and constituents that affect the quality of the water. In Oregon, public water systems with more than three

hookups or serving more than 10 people year-round are regulated by the Oregon Health Authority. There are more than 3,500 public water systems that serve 88 percent of Oregon's population, about 3.3 million people. Fifty-five of these public water systems serve 67 percent of the population. Oregon's public water systems are fed by more than 200 surface water diversions and almost 3,000 groundwater wells.

Each year, drinking water providers must report to their customers the results of mandatory water quality testing they perform on their potable water supplies. Since the 1970s, waterborne disease outbreaks in Oregon have fallen dramatically, from 15 in the 1970s to two outbreaks during the 2000s, largely because of the oversight and protection standards public water systems must meet.

National drinking water regulations are legally enforceable. Both EPA and the Oregon Health Authority can take enforcement actions against water systems that are not meeting safety standards. These programs and requirements help prevent contamination at the water source, through treatment processes, and at the tap to provide a safe supply of drinking water for consumers.

Testing Water Quality in Private Drinking Water Wells

Private drinking water supply wells are not routinely tested for water quality, although state law requires testing at the time of a real estate transaction. A homeowner selling a property with a drinking water well must test the water for nitrate, total coliform bacteria, and arsenic. Within 90 days after the seller receives the test results, the seller must submit the results to the buyer and to the Oregon Health Authority.

In 2004, DEQ obtained a grant from the EPA to create a database and summarize real estate transaction data. The data provides a broad overview of groundwater quality in the state, as well as some specific observations about nitrate levels. Most domestic well tests (82 percent) show nitrate levels below 2 milligrams/liter (mg/L) and reflect background groundwater quality. Approximately 14 percent of the tests showed nitrate levels above background groundwater quality. About 1.7 percent of the wells tested exceeded—were worse than—the federal drinking water standard of 10 mg/L.

CRITICAL ISSUE: IMPROVE WATER QUALITY AND WATER QUANTITY INFORMATION


Aquatic Species Surveying, ODFW


Water Quality Sampling, ODEQ


Identifying Well Locations, OWRD


Streamflow Measurements, OWRD

Oregon has identified significant data gaps that it needs to rectify in order to ensure sound water resources management. The Integrated Water Resources Strategy places an emphasis on groundwater data, which represents one of Oregon's largest data gaps today. Improving our knowledge of water resources also requires investments in inter-agency work, scientific modeling tools, and platforms to share information with the public and other partners.

Groundwater Investigations

Quite a bit of work remains to characterize Oregon's water resources and our future needs.

Much of the work will be led by agencies that already have established protocols and responsibilities in these areas. However, much of the desired information will be gathered by partners through surveys, literature reviews, and local data gathering. Look for the "Research" symbol, signaling actions that may need additional research assistance from partners.

One of the most frequent requests that local planners make of Oregon's natural resource agencies is for better groundwater information, including: Where is it located? How much is available for use? Is it hydraulically connected to surface water? And, is it safe for human consumption?

Oregon has a need for additional groundwater investigations to further understand the relationship between groundwater and surface water, and the availability of both. Conducting groundwater investigations is a priority for the state, which typically evaluates groundwater resources at the basin scale through a cooperative, cost-share science program with the U.S. Geological Survey (USGS). This allows the Oregon Water Resources Department to develop a broad understanding of the groundwater system and to assist state and local planning efforts for future economic development.

A groundwater investigation begins with a "first pass" that develops a water budget for each basin, showing overall volumes of groundwater recharge, discharge, and available water. The Department has completed a "first pass" in three basins in Oregon: the Deschutes Basin, the sedimentary aquifers of the Willamette Basin, and the Upper Klamath Basin. The State has prioritized additional basins for subsequent groundwater studies. These include the Umatilla and its Walla Walla sub-basin (a high priority due to the desire to appropriate additional winter water from the Columbia), and the Hood, Sandy, Grande Ronde, and Powder Basins. Basin studies can take approximately 5-6 years to complete.

Recommended Action 1.A
Conduct Additional Groundwater Investigations

How to implement this action:

- Test water quality in private drinking water wells
- Maintain and install additional monitoring wells
- Partner with USGS to conduct and cost-share additional groundwater investigations
- Assess groundwater administrative areas
- Locate and document exempt use wells 🕮
- Locate and document UICs 🕮

As more questions arise or trends emerge (e.g., a focus on climate change), the Department plans to update studies and conduct a "second pass," asking and answering new sets of questions about groundwater in each basin. Future investigations should be performed in ways that make the most of data collection and cost efficiency. This can be done through continued partnerships among agencies to gather information on both the quality and quantity of the resource, and should include assessments of groundwater administrative areas, private drinking water wells, and underground injection control systems.

Groundwater Administrative Areas

The State of Oregon has more than 20 groundwater administrative areas, designated because water levels were declining at unsustainable levels. These areas should be periodically re-evaluated to assess water level trends, boundary accuracy, and whether these designated areas are meeting the goals of groundwater stabilization, groundwater recovery, and protection of existing water users. In addition, the State needs to dedicate resources to determine whether other areas of the state require groundwater designations, and if so, to what degree.

Locating and Documenting Wells

Oregon needs better information about its wells, both drinking water and stormwater and wastewater systems. Valuable information would include the number and location of such wells, as well as their volume of use.

Private Drinking Water Wells. Oregon currently has inadequate documentation of the number, location, and average water use of private drinking water wells. An estimated 230,000 private drinking water wells exist in Oregon today, with several thousand more drilled each year. Wells were not required to be registered with the state until 1955. Since then, most well location information has been reported only at a very coarse scale (within a 40-acre area). In 2009, requirements were put in place to obtain more precise location information for newly drilled wells of this type.

Underground Injection Control Systems. Injection systems are any manufactured design, structure, or activity that injects flow into the subsurface of the ground. Common uses include stormwater discharge from roads, roofs, and parking lots; remediation of cleanup sites; open or closed loop geothermal systems; industrial process waste; and large onsite domestic waste processing.

The underground injection control systems program is managed in Oregon by the Department of Environmental Quality. The intent is to manage stormwater and other wastewater in ways that comply with water quality laws. There are strict requirements for the protection of underground aquifers, which are categorized in Oregon as potential drinking water sources.

A current requirement for a 500-foot setback (separation) from any drinking water well is posing difficulties, because information about existing UICs is difficult to find. As a result, owners of newly constructed drinking water wells unknowingly find themselves in conflict with injection systems, sometimes placing UIC owners out of compliance with state and federal regulations. There are also no provisions for well drillers to consider UICs that are known to be nearby when the driller is locating a well, nor are there requirements for UIC owners to be notified.

Oregon needs to improve the location information of underground injection control systems to help prevent conflicts with future well development and protect water sources, including evaluating and rehabilitating existing UICs, where needed, to help protect groundwater quality.

The Role of Data in Decision Making

Oregon's surface water and groundwater resources, by their very nature, are ever-changing. By day, month and year, water resources managers need up-to-date information in order to manage the resource and make sound decisions. This requires measurement of baseline conditions, trends over time, and evaluating the effectiveness of our water management programs.

Data-sharing among agencies allows us to make informed decisions and manage our water resources more efficiently. As one example, the Department of Forestry uses water right information from the Water Resources Department to determine whether forest streams serve as sources of domestic drinking water. Streams that serve as a drinking water source trigger more stringent forestry protections.

As another example, information provided by the Department of Environmental Quality and Department of Fish and Wildlife is needed for water allocation decisions at the Water Resources Department. Their input on water quality or fish needs helps determine whether an application for water will be approved, and under what conditions. There are myriad examples among local, state, federal, and tribal agencies, where current and accurate water resources information from one agency partner affects whether the other agency can effectively carry out its mission.

Monitoring and Evaluating Groundwater Levels

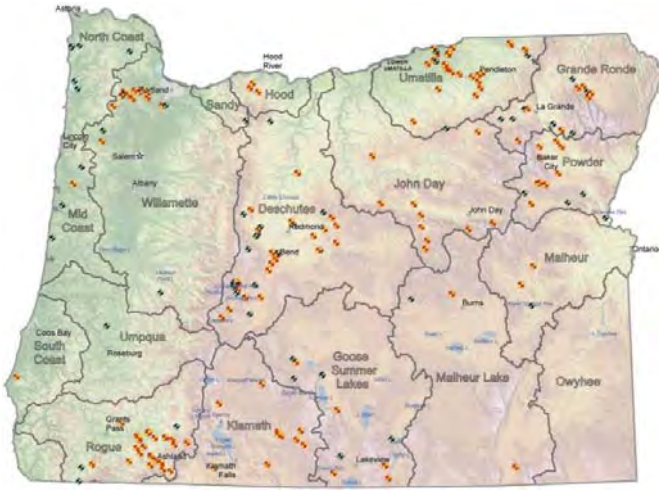
Accurate well location and water level data measured at state observation wells and miscellaneous project wells are critical to help assess groundwater resources. Prior to conducting groundwater studies in a basin, it is necessary to establish long-term water level data sets to accurately evaluate climatic,

seasonal, and groundwater development impacts on the aquifers. As of July 2012, there are 368 state observation wells and 686 miscellaneous project wells active in Oregon. Expanding this network with dedicated monitoring wells, to which staff have year-round access, would help immensely in basins where the State plans to work with the U.S. Geological Survey on cooperative groundwater studies.

Monitoring and Evaluating Surface Water Flows

The Water Resources Department operates more than 200 stream and reservoir gages throughout the state, maintaining a 100-year record for many of them. The Department has operated gages to serve two primary purposes: scientific evaluations and water management (for distribution and regulatory purposes). About 150 of these gages are operated as near real-time, and transmit data once every hour. The Department also shares data from another 225 gages operated by the U.S. Geological Survey.

Operating a stream gage network requires trained hydrographic technicians to keep the equipment operating properly, to conduct regular measurements at various water elevations, and to input the collected information into a central database. Staff review the data, make corrections based on field conditions, and finalize the records to meet computation standards established by the USGS. Currently, the state lacks sufficient capacity to maintain and quickly process data from its network of stream gages. This has resulted in a backlog of unprocessed records, and has hindered the Department's ability to share valuable water resources information.



This network of stream gages is important in the management of Oregon's surface water and groundwater resources. It is used by a variety of agencies and other entities for making daily decisions, protecting and monitoring instream flows, forecasting floods, designing infrastructure such as bridges and culverts, planning for recreational activities, better understanding how much water is available for new uses, and tracking long-term trends such as climate change and drought. The Oregon Department of Environmental Quality, for example, uses streamflow data to calculate the loading capacity of certain pollutants during development of TMDL plans to improve water quality.

Installing and maintaining additional streamflow gages, rain gages, and soil moisture monitoring networks will need to be done in strategic locations, and will need to answer a growing list of questions to meet agency goals at the Water Resources Department, other natural resource agencies, and external partners.

Gaging priorities for water management and distribution needs have been identified in a recent stream gage needs assessment conducted by the Water Resources Department. This evaluation identified the need for more real-time monitoring in most regions to effectively manage water in the face of growing demand and a limited supply. The evaluation identified locations where another 70 stream gages would help watermasters distribute surface water to water right holders; 30 of these gages are a high priority for regulatory, environmental, and logistical reasons. The State needs to conduct further evaluation of the hydrologic data network, including regular coordination among natural resource agencies to identify locations and conditions that require additional monitoring.

The Water Resources Department needs to maintain and add to its monitoring networks to complete an accurate water data record, fulfill its day-to-day management responsibilities, and identify changing trends. Place-based planning efforts could help identify additional data needs, which can include monitoring and evaluating streamflow, groundwater levels, water quality, habitat conditions, and watershed functions.

Monitoring and Evaluating Surface Water Quality

The Department of Environmental Quality, Department of Agriculture, and the Department of Forestry have fundamental water quality data needs as well. Updating water quality standards as necessary helps ensure they are sufficient to support multiple beneficial uses, including protection of public health, recreational activity, aquatic life, and water supply, as does developing Total Maximum Daily Loads for water bodies that do not meet water quality standards.

The levels of some nonconventional pollutants, such as nutrients and sediment, in Oregon's rivers, lakes, and streams have not been adequately defined. Oregon needs to expand the scope and pace of the state-wide water quality monitoring and assessment program, providing information on the status and trends of water quality, causes of impairment, and effectiveness of pollution abatement actions.

Monitoring and Evaluating Groundwater Quality

Because of dwindling budget resources and other water quality priorities, the Oregon Department of Environmental Quality's groundwater quality protection efforts have decreased significantly in the last decade. In the early 1990s, DEQ had 12 staff dedicated to the groundwater program. By the early 2000s, the program staff had decreased to five.

With this level of staffing, DEQ's groundwater program consists of technical assistance, minimal statewide coordination, and implementation of groundwater monitoring and restoration activities in their three designated Groundwater Management Areas (GWMAs) — Northern Malheur County, the Lower Umatilla Basin, and the Southern Willamette Valley.

Recommended Action 1.B
Improve Water Resources Data Collection and Monitoring

How to implement this action:

- Establish dedicated monitoring wells
- Update Oregon's stream gage network
- Implement an on-going state-wide groundwater quality monitoring program
- Prioritize basins for data collection and monitoring
- Evaluate habitat conditions and effectiveness of restoration efforts
- Add remote and real-time capability to monitoring stations

DEQ has been able to identify that nitrate levels in groundwater exceed drinking water criteria in several areas of the state. Nitrate conditions in agricultural landscapes are significantly more impaired than forestlands. However, DEQ does not have adequate resources to conduct a statewide groundwater quality assessment and monitoring program for nitrates or other contaminants. This hampers the State's ability to ensure groundwater resources are adequately protected and to identify areas where contaminated groundwater could present a threat to human health or the environment.

To make the most of monitoring, Oregon needs to implement an ongoing state-wide groundwater quality monitoring program designed to identify a) areas of the state that are especially vulnerable to groundwater contamination; b) long-term trends in groundwater quality; c) at risk populations; d) ambient quality of the groundwater resources of Oregon; and e) emerging groundwater quality problems.

Areas of the state where large portions of the population are dependent on private wells for their drinking water supply should be considered for priority investigation of groundwater quantity and quality.

Monitoring and Evaluating Habitat Conditions and Watershed Functions

The Department of Fish and Wildlife, Oregon Watershed Enhancement Board, and other agencies have significant responsibilities in the area of habitat and watershed monitoring. Habitat and watershed function monitoring includes evaluating channel morphology, substrate, and fish passage issues, as well as wetland and floodplain conditions. *Monitoring* is a broad term that encompasses baseline monitoring, compliance monitoring, status and trend monitoring, and effectiveness monitoring. Diversity of monitoring approaches is essential to building an understanding of watershed health, tracking the success of watershed improvement projects, and setting restoration priorities.

OWEB keeps an inventory of more than 13,000 records of restoration projects completed since 1995. This database is the single largest source of restoration project information in the western United States, and it is used to report on the progress of the Oregon Plan for Salmon and Watersheds, to support effectiveness monitoring of restoration activities, and to inform watershed assessments and future restoration project planning and implementation. Oregon should evaluate the efficacy of floodplain, wetland, riparian, and other restoration programs to help identify future restoration projects with the greatest potential to improve water quality and quantity. Assessing and documenting best management practices from previous restoration efforts is also needed.

While further investments in on-the-ground monitoring are needed to support long-term land and water protection and restoration, Oregon also needs to create guidance for prioritizing watersheds/basins for data collection and monitoring, given the limited funding and staffing resources. There are some watershed-based tools available today to prioritize sensitive water bodies and habitat for future restoration efforts. These tools include the Oregon Conservation Strategy, watershed assessments and action plans, Oregon rapid wetland assessment protocol, and the rapid stream assessment protocol.

Expand Use of LiDAR Technology

Monitoring efforts will benefit from expanding the scope of the State's LiDAR program, which has analyzed about one-quarter of the state – the coast, the Willamette Valley, and most of the Klamath, Deschutes, and Rogue Basins. The Oregon Department of Geology and Mineral Industries leads much of the state's LiDAR-related efforts.

Russell Faux,
Watershed Sciences, Inc.

Use of Airborne Remote Sensing

Airborne Light Detection and Ranging (LiDAR) is a remote sensing, geospatial mapping tool that captures detailed surface terrain data and provides 3-dimensional information about watersheds. LiDAR uses light pulses emitted from a laser, which reflects from terrestrial surfaces; elevations are then computed based on the return time of each pulse.

LiDAR data are used to improve flood hazard maps, evaluate tidal channel topography, inspect infrastructure (dams, levees, canals), model water quality, analyze geomorphology (after dam removal), delineate wetlands, assess faults and other hazards, evaluate habitat restoration, and inventory forests. LiDAR makes assessments of water resources possible in remote, rugged, and inaccessible terrain.

High-resolution LiDAR-derived imagery from the Grande Ronde Basin, Oregon. Data collected for the Bureau of Reclamation.

Enhancing Data Coordination

There are several federal agencies whose data collection and analysis are critical to the understanding of Oregon's surface water and groundwater resources. The U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) and the U.S. Geological Survey are two such agencies. Three additional federal agencies, the U.S. Army Corps of Engineers, U.S. Bureau of Reclamation, and the Bonneville Power Administration are key partners in the operation and contract management of key pieces of water infrastructure, including reservoirs used for power production, water supply, and flood control.

Methods to enhance data collection, processing and sharing include: 1) better integrating federal, state, and local data collection efforts, while adhering to quality control standards; 2) improving data collection standards, manuals, training, and technical support; 3) providing on-line platforms for data submittal and quality control; 4) adding remote and real-time monitoring to existing stations; and 5) processing the backlog of water quantity and water quality data. Several years' worth of data still needs to be processed, analyzed, and shared with the public and other partners.

Recommended Action 1.C
Coordinate Inter-Agency Data Collection, Processing, and Use in Decision-Making

How to implement this action:

- Coordinate federal, state & local monitoring and data efforts
- Improve and integrate data from partners
- Process backlogs
- Improve availability of information
- Invest in scientific modeling tools
- Map major water institutions, documenting their responsibilities, programs, data 🕮

The lack of stable resources to maintain the state's monitoring networks, to collect and share data, to conduct studies, and to develop modeling tools has presented a significant, ongoing challenge.

Making Water-Related Information Available

Currently, water-related program information, contact information, and data are often not available from agencies, or sometimes difficult to find and use. While agencies have made great strides scanning older documents and making newer documents available online in a searchable format, investments in information technology have declined in recent years, causing agencies to fall behind their private sector counterparts.

In a culture that relies on instant access to information, agencies are still in the process of making historic documents available while working to make their data more interactive (i.e., searchable, accessible as a map layer). Agencies are also trying to keep fact sheets and how-to-guides accurate and up-to-date.

Agencies at all levels of government need to upgrade websites, FTP sites, and other electronic means to make water-related information readily available and usable.

Investing in Scientific Modeling Tools

Increasingly, communities are asking state agencies for technical assistance in modeling future scenarios related to climate change, energy and economic development, and the implications of various land use policies on water resources and management. Such models are helpful for demonstrating what the range of results would be if a community were to invest in one water project instead of another, or if it were to invest in a combination of projects. Many data-intensive models are typically outside the financial and technical capacity of local governments.

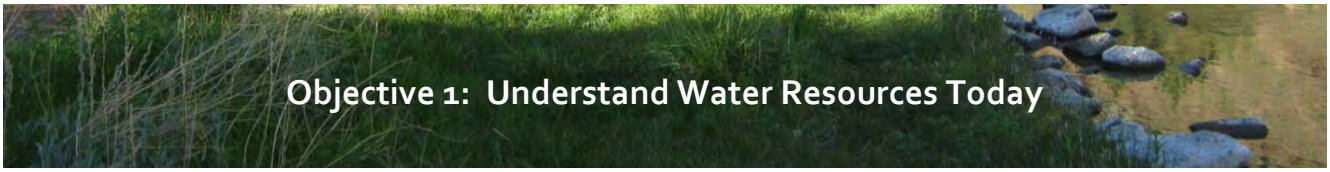
The State needs to invest in the tools and scientists needed for modeling and testing future scenarios. Developed transparently and at the appropriate local scale, such models can provide powerful tools for decision-making and help prioritize investments in water resources projects.

Investing in Inter-Agency Work

The State could do better when it comes to integrating state agency functions related to water. It can start by "mapping" Oregon's major water-related institutions and documenting their involvement in water resource management at the local, state, federal, and tribal levels.

The next step is describing their areas of responsibility, relevant programs, available data, and areas of interaction. Doing so will strengthen the public's understanding of inter-agency linkages. It will also help to identify areas where agencies can improve coordination in data collection, field work, and decision-making.

Recommended Actions at a Glance



Limited Water Supplies & Systems; Water Management Institutions; Water Quality/Quantity Information	1.A. Conduct additional groundwater investigations 1.B. Improve water resource data collection and monitoring 1.C. Coordinate inter-agency data collection, processing, and use in decision-making

CHAPTER 2

UNDERSTAND OREGON'S INSTREAM & OUT-OF-STREAM NEEDS

Photos (clockwise from top): Rick Swart, ODFW; Travel Portland; Kyle Gorman, OWRD; The Knowles Gallery

Out-of-Stream Needs

Instream Needs

Oregon has granted water rights for many beneficial uses, some of which include general agricultural use, irrigation for crops, domestic and livestock use, power development, commercial use, and municipal use. Water rights have also been established to protect instream uses for the benefit of fish, wildlife, recreation, and water quality.

Oregon needs a better grasp of its current and future water needs and demands, both instream and out-of-stream. Without a better characterization of water use today, the State cannot adequately plan to meet these needs sufficiently and sustainably in the future.

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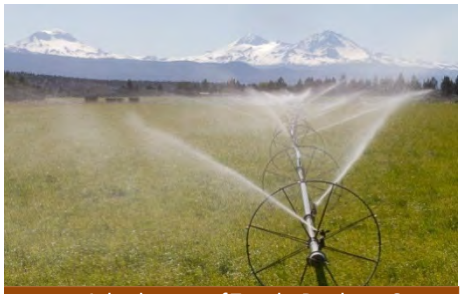

Irrigation west of Tumalo, Deschutes County


Safe Drinking Water


Downtown Portland & Mt. Hood

Photos: K. Gorman, OWRD; B. Bateman, OWRD; Gary Halvorson, Oregon State Archives

Out-of-stream uses are those that divert water from a stream, reservoir, or from below ground to serve a beneficial purpose. The major uses of diverted water in Oregon are to supply the water needed for agricultural, municipal, and industrial purposes. Approximately eighty-percent of water rights authorize the use of surface water from rivers, streams, and reservoirs, with the majority of the water being used for agricultural irrigation. The remaining 20 percent of water rights authorize groundwater use. Uses that divert water are often considered a consumptive use.

The following sections examine in more detail how water put to use out-of-stream contributes to Oregon's economy, public health and safety, and quality of life.

Water Use in Agriculture

A large majority of agricultural irrigation water comes from Oregon's rivers, streams, and reservoirs. The 2008 water demand forecast noted in the accompanying essay indicated that irrigated agriculture uses an estimated 85 percent of the water that is diverted in Oregon. Of that, 66 percent is in the eastern and southeastern counties of the state where large irrigated areas exist: Baker, Crook, Deschutes, Harney, Jefferson, Klamath, Lake, Malheur, Morrow, and Umatilla counties.

Irrigation is applied to about half of the state's total crop land (1.7 million acres). Oregon ranks third of all states in the number of farms that use irrigation, and ninth of all states in the number of acres irrigated.

Contribution of Irrigated Agriculture.
Oregon agriculture provides a bounty of food and fiber products that are sold and consumed in Oregon and around the world. Without water, none of this is possible. Virtually all fruits and vegetables grown in Oregon are produced through irrigation. Yields of other crops, including grains, can increase up to 500 percent, if irrigated.

Irrigated agriculture in Oregon contributes significantly to the economy, food supply, the landscape, and to local communities. Irrigated agriculture produces 77 percent of the total value of Oregon's harvested crops. Preliminary

Ronan Igloria, PE, CWRE,
HDR Engineering, Inc.

Long-Term Forecasting Tools Help Estimate Oregon's Future Water Needs

In 2008, HDR Engineering developed a tool to help the state forecast long-term water demands, estimating an increase in Oregon's water demands from 9.1 million acre feet in 2008, up to about 10.3 million acre-feet in 2050 (assuming that factors such as per capita water use and crop water needs stay the same).

The forecast also accounted for uncertainty by identifying a range of outcomes for baseline, water conservation, and climate change scenarios.

The forecasting tool was designed to be transparent and flexible as more information becomes available, allowing data such as per capita water use, industrial needs, and crop needs to be updated. The tool can be accessed and downloaded online through the Oregon Water Resources Department's conservation and supply resources page.

figures show Oregon's 2010 agricultural production value at $4.4 billion. That figure, and the value of irrigated agriculture, grows considerably if you include food processing, agricultural support services, wholesale trade, transportation and warehousing, retail trade, and food services establishments.

Oregon's farms, vineyards, orchards, nurseries, and ranches contribute significantly to county economies as well, providing jobs, related goods and services, and a tax base critical to county budgets.

The contribution of agriculture to Oregon's environmental health is not insignificant either. Many agricultural fields serve as a view shed of open, green landscapes, and can provide a sanctuary for migratory birds. Well-managed agricultural lands can support a variety of wildlife, providing food, shelter, and habitat. Irrigation can multiply these benefits, further contributing to soil conservation, biodiversity, wildlife habitat, recreational opportunities, scenic vistas, watershed protection, flood control, and groundwater recharge.

Conservation Successes. Many irrigators have worked extensively with both public and private sector partners to install and model some of the most modern water conservation and habitat restoration techniques. These include fencing riparian areas and building stock water troughs to protect sensitive riparian areas from cattle. It also includes adoption of more efficient water delivery and irrigation practices. The industry boasts a number of successes with fish screen installations as well.

Oregon's 2011 report from the State Board of Agriculture describes Oregon's irrigation systems as some of the most sophisticated in the world, using state-of- the art technology to capture, move, distribute, and place water for use with crops.

Irrigation advancements over the past 25 years include low-pressure systems and sprinklers, variable speed pumps that adjust to water usage needs, soil moisture testing linked to weather data and computer controlled irrigation, and central pivot systems that are efficient and economical.

Other agricultural technologies that extend efficient water use include better seed and crop varieties, improved use of soil amendments and management activities, and innovative mechanization. These practices, coupled with irrigation, have increased yields by more than 500 percent since the 1930s.

Although much of the water is used to irrigate crops, there are many other uses for water within agriculture, such as water for livestock operations, which is necessary to support Oregon's high ranking commodity – cattle and calves – valued at $493 million in 2010.

Photo/description courtesy of Oregon Dept. of Agriculture

This off-grid solar livestock watering system provides a reliable source of water for livestock and wildlife, while also improving rangeland and streamside health.

Food Processing

According to the Northwest Food Processors Association, Oregon's 200 food processors directly employ more than 23,000 people. They play an essential part in food production by cooking, freezing, and packaging products for consumers. In the greater Pacific Northwest, food processing is the third largest manufacturing sector, with annual revenue of $21 billion and more than 100,000 employees.

The food processing industry handles crops from cherries to onions and includes bakery and dairy products, fruits and vegetables, meat, poultry, and seafood. This is a water-intensive industry in which water is needed for washing, processing, and packaging food. Finding a high quality water supply to meet the needs of this industry is sometimes a challenge.

Self-Supplied Industrial and Commercial Water Use

Self-supplied industrial water use in Oregon represents approximately 6 percent of the water diverted in Oregon. This percentage represents industrial and commercial facilities that maintain their own water supplies and water rights independent of public water systems. It is important to recognize that much of the state's industries are not "self-supplied." Most commercial, industrial, and high-tech facilities receive water from municipal water providers.

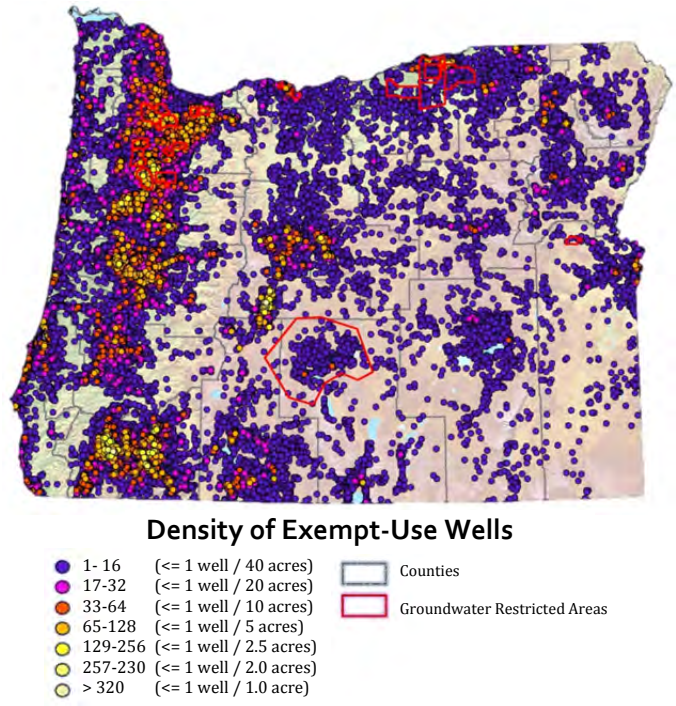
For self-supplied industrial demand, Multnomah, Lane, Columbia, Clatsop, Clackamas, Marion, and Linn counties comprise 62 percent of the total for this category. Other counties with relatively large self-supplied industrial demands include Coos, Umatilla, Deschutes, and Douglas counties, which comprise 15 percent of the total demand.

Industrial use involves using water within the processing or manufacturing of a product. Water can be used to construct, operate, and maintain industrial sites and facilities. Commercial use is very similar. It includes the use of water for the production, sale, or delivery of goods, services, or commodities, along with the use of water to construct, operate, or maintain a facility.

Self-Supplied Domestic Water Use

Domestic wells, serving populations outside of public water systems, account for about one percent of water demands in Oregon. Although this figure is small in comparison to other out-of-stream demands, the U.S. Geological Survey estimates that in 2005, more than 707,000 Oregon residents relied on groundwater from private wells to meet their domestic water needs.

Such wells, used primarily for domestic drinking water, are prevalent throughout the state. As shown in the accompanying map, these wells are located in both rural and urban areas, and total an estimated 230,000. The largest domestic groundwater demands are in Deschutes, Clackamas, Klamath, and Lane Counties, followed by Jackson, Washington, and Josephine Counties. These counties comprise more than half of self-supplied domestic groundwater demands in the state.



Municipal Water Use

Municipal systems may be shared water systems operated by homeowner associations, larger systems managed by private water companies, or public systems operated by cities, towns, or water districts. Although municipal water use only represents approximately 6 percent of out-of-stream demands, municipal water systems in Oregon deliver drinking water to about 88 percent of the state's population, about 3.3 million people.

Municipal water systems are crucial to the state's economy, serving as a backbone of economic development, public health, and safety in many Oregon communities. These water providers supply clean and reliable water to businesses, residences, schools, parks, hospitals, and other public and private facilities. In the past decade, employment in manufacturing has largely been located in

urbanized areas where access to a public water system has played an important role. As of June 2011, the six metropolitan areas in Oregon (Portland, Eugene, Salem, Medford, Bend, and Corvallis), had 1.4 million jobs, which accounts for the largest portion of Oregon's total non-farm employment. The ability of municipal water systems to deliver reliable, high quality water supplies is one factor that has attracted industry to Oregon.

Population growth and economic development are pressures that municipal systems must address. According to the Office of Economic Analysis, since 1950, Oregon's population has increased by 150 percent and has done so at a faster pace than the U.S. population as a whole. Today, more than 3.8 million people call Oregon home, and the 2010 Census shows Oregon's urban areas are continuing to grow. By the year 2040, it is anticipated that the state population will reach 5.4 million.

Economic growth in Oregon depends, in part, on the availability of water and wastewater services, and the ability of municipalities to serve these needs. Municipalities in Oregon will continually need to estimate long-range water supply demands and to identify options, including water conservation programs, to meet future needs.

Municipalities are responsible for forecasting water and wastewater demands and providing services to all who locate within their service territory. They estimate the growth that might occur five, ten, even 50 years into the future and they must be ready to serve that need.

Updating the State's Long-Term Water Demand Forecast

Updating Oregon's long-term water demand forecast, improving water use measurement and reporting, and updating basic water right and permitting information allows for good water management.

The State must regularly update its fifty-year forecast of water needs across all sectors. Last conducted in Oregon in 2008, such a forecast includes identifying trends in water use, economic development, agriculture, urban-rural population growth/shift, per capita demands, industrial and energy sector demands, and the anticipated effects of conservation and efficiency improvements.

Recommended Action 2.A
Update Long-Term Water Demand Forecasts

How to implement this action:

- Update the state's long-term water demand forecast 🕮
- Update crop water-use tables 🕮
- Quantify/model economic value of instream and out-of-stream water 🕮
- Enhance the state's water use reporting system

Future demand forecasts should also analyze future needs for the state's key growth industries – advanced manufacturing, clean technology, forestry and wood products, high technology, and outdoor gear and apparel.

Updating the long-term demand forecast should also involve developing water demand projections for areas planned for urban and industrial growth and updating crop water use requirements. In Washington State, extension agents are updating their crop water requirements with new data, and find in many cases that less water is needed than was previously thought.

Another piece of the forecasting picture is to incorporate long-term water demand forecasting into place-based, integrated water resources planning efforts, using methodologies accepted by the State. For further discussion of place-based efforts, refer to page 79.

Quantifying and modeling the economic value of water (both instream and out-of-stream) will add to the value of such forecasts. As already discussed, productivity of land and crop production are increased several-fold with the application of water. This expands the options of crops that can be grown, lowers the risk of impacts from weather and disease, and enables economic growth beyond the farm.

This type of economic analysis is of critical importance to the U.S. Bureau of Reclamation, the Oregon Watershed Enhancement Board, and other major funding agencies, where economic information is needed to assess the costs and benefits of potential projects or proposals.

Improving Water-Use Measurement and Reporting

Good water management decisions are made possible when they are based on reliable information about water resources. Water-use data is a fundamental tool to ensure efficient water management, effective water distribution, and to help plan for future water needs. The information is also used to ground truth demand projections or modeling efforts by state and local entities. Water users who keep track of their use are better able to demonstrate the validity of their water rights to potential buyers.

Oregon requires governmental entities such as irrigation districts and public water providers to measure and report water use. Certain types of water use are also required to be measured and reported, in accordance with the conditions of a water right or permit. The Water Resources Department has not had a consistent budget to oversee and coordinate the State's Water Use Reporting Program for several years.

Budget reductions in recent years have dramatically hampered the Department's ability to review and process water-use data, ensure compliance, and offer technical assistance to water users. Even with an online reporting system in place, recent reports show compliance dropping to as low as 20 percent during periods without staff oversight to provide assistance to those tracking and reporting water use data.

Water Measurement Strategy

In 2000, the Water Resources Commission developed a strategic plan for improving water measurement statewide. The Plan focuses on measurement of diversions with the greatest impact on streamflows in areas with the greatest needs for fish. The Water Resources Department developed a statewide inventory of approximately 2,300 "significant diversions" within 300 high priority watersheds across the state. This represents about 10 percent of the all diversions in these watersheds, but accounts for about 50 percent of all water diverted in the state.

The Department's field personnel are currently working with landowners to fully implement the Commission's Measurement Strategy, installing measurement devices (e.g., weirs, flumes, and meters) at these significant diversions. By 2011, more than 640 measurement devices had been installed.

Recommended Action 2.B
Improve Water-Use Measurement and Reporting

How to implement this action:

- Reinstate a water-use reporting coordinator at WRD
- Fully implement the State's Water Measurement Strategy; offer cost-share dollars
- Encourage businesses to conduct self-evaluations of water use
- Employ remote-sensing

Cost share dollars for measurement devices are critical to the program's success and reaching the Department's performance target of installing measurement devices on 175 significant diversions each year. These cost share dollars have been available through the Department for the past several years and the funding should be recapitalized on a regular basis.

Oregon's business community should also be encouraged to conduct self-evaluations of water use, considering the physical and legal availability of water world-wide is a continuing challenge to businesses of all kinds. Several organizations have made tools available online to businesses who want to benchmark their own water use and assess the risks associated with reliance on water. The *Ceres Aqua Gauge™*, released online in October 2011, provides a benchmark for best practices and enables investors to assess and compare companies on their management of water risk (see ceres.org/aquagauge).

In addition, the use of evapotranspiration data, discussed in the following essay, is an emerging measurement tool that may help the state better understand the location, timing, and quantity of water use in the future.

Hal Anderson,
Idaho Water Engineering

METRIC: A Model for Tracking Evapotranspiration Data Using Satellite Data

Evapotranspiration (ET) is water that transpires from the leaves of plants and evaporates from soil. Evapotranspiration data can quantify the amount of water consumed by irrigated agriculture and by other lands. ET data is generated through a satellite-based model called METRIC (Mapping Evapo-Transpiration using high Resolution and Internalized Calibration). METRIC uses digital images from the Landsat satellite, obtained free from the U.S. Geological Survey.

The METRIC model helps to provide accurate water distribution information and identifies trends in agricultural water use. It also helps to confirm compliance with water rights, crop conditions, and can ensure the accuracy and validity of water right transfer proposals.

In Oregon, the U.S. Bureau of Reclamation and local partners use METRIC to better understand the location and quantity of water used in the Klamath Basin.

Updating Water Related Records

This subsection addresses three pressing needs related to the update and modernization of water-related records: determining pre-1909 water right claims, modifying names on water right certificates, and updating Oregon's water-related permitting guide.

Determining Pre-1909 Water Right Claims

Passage of the water code in 1909 established, for the first time in Oregon, a centralized administrative system for acquiring, certifying and documenting rights to the use of water. These water rights are then managed within a prior appropriation system of water allocation.

Recommended Action 2.C
Determine Pre-1909 Water Right Claims

How to implement this action:
- Complete un-adjudicated areas
- Settle federal reserved claims, including tribal claims
- Settle groundwater claims

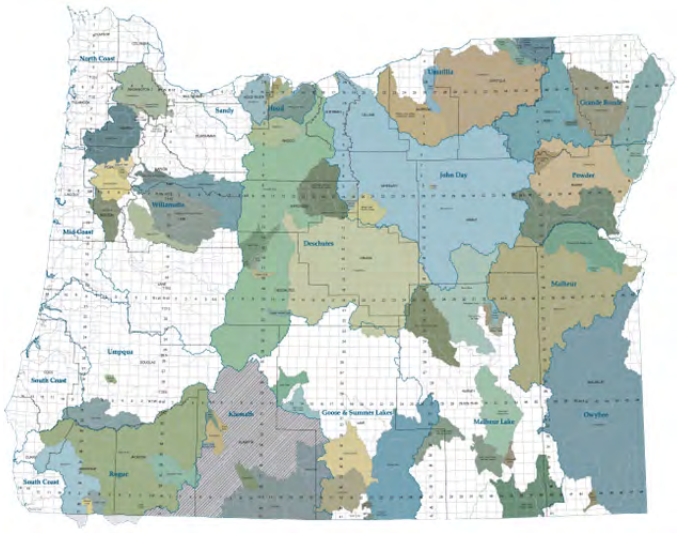
Holders of vested water rights established prior to 1909 include those claimed by Indian Tribes by virtue of treaties with the U.S. Government. These claims are required to go through a formal administrative, judicial process known as adjudication, to have their water right claims quantified, documented, and eventually incorporated into the prior appropriation system. Tribes are important partners in the resolution of water rights claims in basins throughout the West. The need to resolve tribal claims in Oregon are real and significant.

The ability to manage water resources has been greatly facilitated in those areas of the state where adjudications have been concluded. By creating a record of enforceable water rights through the adjudication process, water users have greater security, predictability, and flexibility in meeting their own needs.

Large areas of the state, such as the Klamath River Basin, have not yet been adjudicated. The administrative phase of the Klamath Adjudication, underway since 1975, is scheduled for completion in early 2013. Completion of this phase will greatly enhance the ability to manage water resources in the region.

The remaining unadjudicated areas of the state, which consist primarily of river basins located west of the Cascades, must be completed. See accompanying map.

Related tasks include settling federal reserved claims, including tribal claims, in basins that were previously adjudicated, and establishing priorities for that work. Another remaining task is settling groundwater claims and establishing priorities for that work.



Updating Contact Information

Today, there are no statutory provisions allowing the name on a water right certificate to be changed or updated, even if the holder of the certificate has passed away or sold off interests. Approximately 70,500 certificates are held by water users throughout the state. The State needs the ability to respond to holders of water rights who are asking to modify the names on these certificates. This will also help facilitate Department processes, such as communicating with water right holders, researching water rights, mapping water rights, updating the water rights database, and improving compliance with measurement and reporting conditions.

Recommended Action 2.D
Update Water Right Records with Contact Information

How to implement this action:

- Authorize WRD to update names on water right certificates
- Update related water right database and GIS records
- Rule-making should specify acceptable documentation

Updating Oregon's Water-Related Permitting Guide

In Oregon, protecting our natural resources and the benefits they provide us means a variety of permits and reviews from several state agencies may be required for residential, commercial, industrial, or public works projects. The primary purpose of these requirements is to avoid and/or minimize any impacts to Oregon's waters where possible and compensate (or mitigate) where impacts cannot be avoided. Examples of types of permits or requirements include water-use (permits, transfers, limited licenses); compatibility with local comprehensive land use plans (cities and counties); state and federal removal/fill permits; stormwater and wastewater discharge permits for industrial, municipal, and commercial facilities; construction approval activities within a scenic waterway; fish passage requirements; and archeological reviews.

The permitting process can seem complicated to the observer, involving input from multiple agencies and the public. Evaluating an application to use water, for example, is an interagency effort that requires coordination among different natural resource agencies to ensure that water quality, ecological needs, and land use goals and requirements are integrated into the decision-making process.

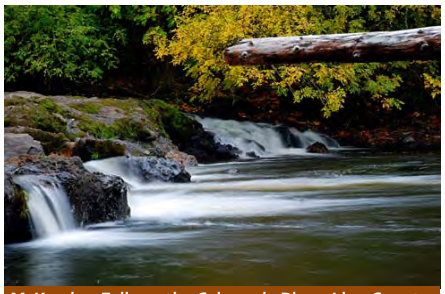
Recommended Action 2.E
Update Oregon's Water-Related Permitting Guide

How to implement this action:
- Provide updated agency contacts, policies, links
- Provide industry-specific information where possible

The Water Resources Department acts as the lead, soliciting comments from other agencies and the public, and often conditions new water uses based on those recommendations. New surface water uses are conditioned with fish passage or screening requirements to protect sensitive, threatened or endangered fish species. The Water Resources Department has recently instituted several low or no cost improvements to its application process, resulting in the automation and facilitation of interagency communication, and an easier, more simplified process for water users.

In 2008, the State published a comprehensive, yet simple reference for the regulatory and nonregulatory programs that influence the permitting of projects in wetlands and waterways in Oregon. Oregon's permitting guide should be updated with new contact information, web links to application forms, review standards, and references to applicable rules.

CRITICAL ISSUE: FURTHER DEFINE INSTREAM NEEDS / DEMANDS


McKercher Falls on the Calapooia River, Linn County


Coho Salmon in Cedar Creek, Clackamas County


Columbia River, The Dalles, Wasco County

Photos: Gary Halvorson, Oregon State Archives; and Rick Swart, ODFW

The water resources within Oregon provide endless recreational opportunities, serve as scenic attractions, and directly support the habitat needed for species to live and thrive. Oregon's rivers and streams, its lakes, reservoirs, aquifers, wetlands and estuaries all contribute greatly to Oregon's economy. Without adequate water within the system, instream uses and their associated ecological and economic benefits are threatened.

Water Instream Supports Economic Health

Navigation

The state's waterways have long served as important routes for travel and trade. Even today, many of the agricultural products grown in Oregon and elsewhere in the United States move down the Columbia River by barge, via the Port of Portland. Instream flows have facilitated ocean-going and river-going commerce, and promoted economic activity at many ports and cities in Oregon.

Water-Related Recreation and Tourism

The focal point of many recreational activities in Oregon is often a river, waterfall, lake, wetlands, or a snow-covered mountain. Water resources offer opportunities for skiing, boating, kayaking, rafting, canoeing, camping, hiking, fishing, and observing wildlife, all of which greatly contribute to Oregon's economy.

According to a 2006 national survey by the U.S. Fish and Wildlife Service, 87.5 million residents fished, hunted, or watched wildlife in the United States, spending more than $122 billion and contributing to millions of jobs in industries and businesses that support fish and wildlife-related recreation.

Closer to home, a study completed by the firm of Dean Runyan and Associates looked specifically at county and state expenditures and found that, in 2008, nearly 2.8 million Oregon residents and nonresidents fished, hunted, shellfished, or watched wildlife, resulting in expenditures of $2.5 billion. These expenditures include transportation expenses, accommodations, recreational fees, food and beverage services, and equipment purchases. Many of Oregon's counties, such as Harney, Lake, Morrow, and Wheeler County, receive a significant boost to their local economy from those who travel to participate in fish and wildlife recreation activities. The economic value of fish and wildlife recreation is one of the many reasons for protecting Oregon's water instream for the benefit of future generations.

Many of Oregon's day-use parks and overnight camping facilities reside along scenic rivers and lakes. The Oregon Parks and Recreation Department manages more than 360 properties that include day-use areas and overnight camping facilities available for public use. In 2009, more than 2.5 million people stayed overnight and 41 million people visited day-use areas. Oregon ranks among the nation's top ten in state park overnight and day-use attendance. Combining visitor expenses for both state and federally managed parks, visitors spent $222 million on travel-related expenses to use public campground facilities in 2009.

There were nearly 2.8 million boat-use days in Oregon during the 2010 boating season, according the Oregon State Marine Board's triennial survey of recreational boaters. A "boat-use day" is any portion of a 24-hour period in which a participant is engaged in boating activities. Boaters divide their time evenly between rivers and lakes/reservoirs. The Columbia and Willamette Rivers are the most popular rivers, and Detroit Lake and Lake Billy Chinook are the most visited reservoirs.

Although water-related activities such as sailing, waterskiing, and wakeboarding have declined about 20 percent since 2004, the use of manually powered boats for kayaking, rafting and canoeing are gaining in popularity. Thirteen percent of Oregonians participated in paddling activities during 2005, according to an Outdoor Industry Foundation report. Nationally, more Americans participate in paddling activities than soccer.

Fisheries

Instream flows support Oregon's recreational and commercial fisheries. Fishing remains the highest use activity for boaters. Native fish such as salmon are an Oregon icon and support a vigorous recreational and commercial fishing economy. According to the American Sportfishing Association, in 2006, there were seven million fishing days spent by Oregon residents and non-resident freshwater anglers and 846,000 fishing days spent by resident and non-resident saltwater anglers. In 2006, the economic impact of sport fishing in Oregon, in both freshwater and saltwater environments, totaled more than $623 million in retail sales, supporting more than 11,000 related jobs in Oregon, and generating an economic output of more than a billion dollars. More Americans—nearly 40 million—spend time fishing, than playing golf and tennis combined.

According to an Oregon Department of Fish and Wildlife briefing report on Oregon's commercial fishing industry, more than 285 million pounds of fish were delivered to Oregon ports in 2011. The harvest

value of Oregon onshore landings was $145.5 million, a 23-year high for the industry. The estimated total personal income generated by Oregon's commercial fishing industry (onshore and distant water fisheries) in 2011 was $518 million. The harvest value of the Dungeness crab fishery typically dominates the commercial fishing industry, and accounted for about 30 percent on the onshore landing harvest value in 2011.

Commercial fisheries support thousands of jobs and a number of communities along the Oregon Coast (Astoria/Warrenton, Garibaldi, Depoe Bay, Newport, Winchester Bay, Coos Bay/Charleston, Port Orford, Gold Beach and Brookings). In some towns, commercial fisheries provide up to a third of all the annual earned income. A healthy fishery can support a cluster of fish processing plants, mechanics, machine shops and welders, refrigeration specialists, marine electronics sales and service firms, and marine suppliers. Healthy fisheries also support the traditional and cultural identity of many Oregon communities. Northwest tribal communities, for example, have historically relied on salmon and other fish species as a major food source, a foundation of life, culture, economy, and spirituality. Because of Oregon's collective interest in the health of its fisheries, management responsibilities are shared among state, federal, and tribal agencies.

Water Instream Supports Ecosystem Health

Along with supporting the economy, water is needed within the environment to ensure overall ecosystem health. Some springs, rivers, lakes, and wetlands are dependent on the discharge of groundwater to the surface. Other ecosystems such as forests, riparian areas, and some types of wetlands are dependent upon a water table located close to the surface. Aquifer and subterranean ecosystems rely on groundwater further below the surface.

There are certain stream conditions that are necessary to support the life cycle of fish species. The water quality, water quantity, and habitat needs also vary by species. Coho, for example, need gravels that are clean with various sizes to create nests and deposit their eggs. They prefer to spawn and rear in small, relatively flat streams. Cool clean water is a requirement for fish rearing, as well. Wetlands, off-channel pools, and other slackwater areas provide small fish (fry) with safe areas to reside in during the winter season when the current is swift. The complexity of the habitat directly contributes to the health and function of fish-bearing streams.

Understanding Base Flows and Elevated Flows

Flow functions are often grouped into the following categories:

- **Base Flows** are the instream flows needed to sustain basic life stage functions and are important for maintaining habitat conditions, scenic and aesthetic values, and protecting water quality. Often called subsistence or minimum habitat flows, they represent the minimum flow functions of a stream that provide the necessary direct habitat for fish and other aquatic organisms. They may also represent the minimal flows needed to provide sufficient water quantity to overcome the potential for threats to aquatic life from harmful pollutants or stream heating. We currently lack a comprehensive understanding of the base flows needed to support fish habitat. While there is information about base flow needs for the high-profile salmonid species, today, there is not much information about base flow needs for other species including lamprey, chub, white fish, other native fish species, amphibians, or macroinvertebrates.

- **Peak and Ecological Flows** are elevated flows and are a subset of instream flows that are directly related to the ecology of the stream system. These flows serve multiple functions. For example, biological triggering flows represent elevated streamflows that may

trigger a behavior in an aquatic organism that is essential for its survival, such as migration or spawning. Channel habitat maintenance flows, by comparison, are elevated streamflows (often flood or peak flows) that rework the channel or its streambed, rejuvenating or cleaning gravel, reforming habitat features, replenishing or rejuvenating riparian vegetation, and/or re-establishing connectivity with off-channel habitats.

A healthy stream experiences base flows as well as a variety of elevated flows that provide habitat maintenance and other ecosystem functions. The essay below lays out in clear terms the importance of base flows and elevated flows in stream systems.

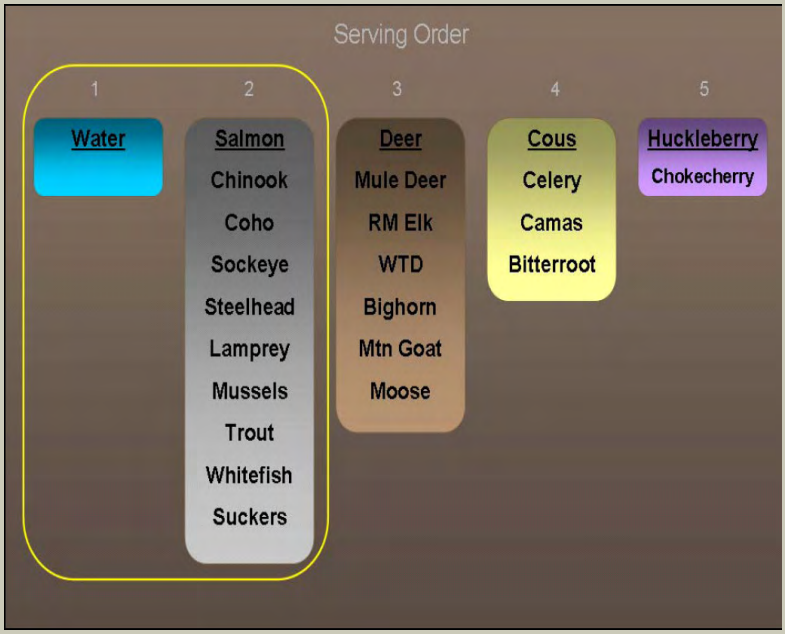
An excerpt from The Umatilla River Vision
by Krista L. Jones, Geoffrey C. Poole, Eric J. Quaempts, Scott O'Daniel, and Tim Beechie, May 2011

Streamflows in Context: The Umatilla River Vision

The Department of Natural Resources (DNR) of the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) has adopted a mission based on First Foods ritualistically served at tribal meals.

The First Foods mission is to protect, restore, and enhance the First Foods—water, salmon, deer, cous, and huckleberry - for the perpetual cultural, economic, and sovereign benefit of the CTUIR. We will accomplish this utilizing traditional ecological and cultural knowledge and science to inform: 1) population and habitat management goals and actions; and 2) natural resource policies and regulatory mechanisms.

The First Food serving ritual is based on Tribal creation belief and reminds people of the promise the foods made to take care of people and the people's reciprocal responsibility to respectfully use and take care of the foods. The longevity and constancy of these foods and serving rituals across many generations and their recognition through First Food ceremonies demonstrate the cultural and nutritional value of First Foods to the CTUIR community.



The First Foods serving order with an example list of ecologically related species for each serving group. The yellow outline highlights primary components guiding development of the river vision.

Water is both a First Food, and a resource required to produce all other First Foods. Thus, within the First Foods management framework, the concept of "water quality" takes on a broader meaning. In addition to using conventional physio-chemical measures, evaluation of water quality in the Umatilla Basin must also include appropriate measure of biotic communities (e.g. native species abundance and diversity) and hydrologic processes (e.g., flow regime) associated with high ecological health.

Essay continued, next page

Essay continued...

We outline a vision for desired ecological characteristics of the river's water quality and water resource management, which will facilitate the sustained production of First Foods. These characteristics are founded on five fundamental "touchstones," including; 1) hydrology – flow quantity and seasonal timing, 2) floodplain geomorphology, 3) hydrologic connectivity, 4) native riparian vegetation, and 5) native aquatic biota. Each of these touchstones includes a robust list of data needs to understand and improve in each of these issue areas. This approach is meant to help both tribal and non-tribal natural resource managers.

Sound river management and restoration are predicated upon the need to develop a systemic and holistic vision of a functional river. Such a vision provides a framework for planning management or restoration efforts and an initial benchmark for assessing management success or failure. Similarly, a river vision provides the context necessary for understanding the role of any specific management decision or action in the context of other decisions or actions. Our vision is as follows:

"A healthy river is capable of providing First Foods that sustain the continuity of the Tribe's culture. This vision requires a river that is dynamic, and shaped not only by physical and biological processes, but the interactions and interconnections between those processes."

A functional river requires preserving or restoring the seasonal timing and volumes of river flows necessary to support the production and harvest of First Foods.

Base flow conditions (low flows during the late summer and early autumn) in the Umatilla River determine the availability of aquatic habitats within the river as well as summertime hydrologic connectivity within the river network. Thus, summertime migrations of salmon, lamprey, and other species are influenced by the magnitude of base flow. Base flows in any given year also influence water quality (since concentrations or pollutants are influenced by flow volume) and even the temperature regime of the river.

In addition to base flows, management planning for desired flow regimes requires consideration of the magnitude and frequency of peak flow events. Peak flow events maintain the dynamic nature of the floodplain morphology and channel pattern, which facilitates the flux of river water through floodplain gravels and maintains a variety of aquatic habitats in the channel and across the floodplain. For example, floods that are sufficient to mobilize the streambed are critical to the ecological function of the river.

Such high-flow events provide temporary surface water connections between main channel and off-channel aquatic habitats, build and rearrange important channel and gravel-bar features across the floodplain thereby maintaining habitat diversity, enhancing water movement through the floodplain aquifer by cleaning and sorting river sediments thereby facilitating hyporheic* water flux, and recharging the alluvial aquifer with water. [**Hyporheic refers to mixing of subsurface and surface water. Note added.*]

A functional river, then, is dependent on the sufficient magnitude and frequency of flood events to maintain dynamic channel patterns and adequate water exchange rates between the channel and floodplain sediments.

Finally, the transitional periods between peak and base flows are also ecologically important. The "falling lim" (reduction in river flow after a period of high water) of the annual hydrograph during the early summer can be ecologically important for spawning of fishes, establishment of cottonwoods, and maintenance of vernal pools on the floodplain for floodplain amphibians. Additionally, when rivers drop too rapidly from a peak flow to base flows, fish can be trapped in transient off-channel habitats on the floodplain that may dry

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up as the flood recedes. The hydrograph of a functional river, then, would include transitions between high flow events and low flow events that are compatible with maintenance of the native aquatic community of the river.

In addition to the volume of water in the channel, a functional river is defined by the physical, chemical, and biological aspects of water quality. The river should be free from pollutants (e.g., toxicants or excess nutrients) that impair drinking water supplies, alter stream water pH, and stress or kill native aquatic fauna.

Maintenance of appropriate water temperature regimes, including cool temperatures during the summer, is especially important because water temperature influences dissolved oxygen concentrations, stress levels of aquatic organisms, growth of pathogens, and the competitive abilities of non-native fishes versus native fishes. In short, a functional river would have nutrient and contaminants levels that do not impede First Foods production and the utilization and safe consumption of First Foods by the tribal community.

The First Foods-focused mission highlights direct linkages between the ecological health of the rivers and the health and well-being of Umatilla tribal members. Degradation of the river, water quality, and associated ecological processes results in the loss of traditional tribal foods. This loss of food resources is linked to increasing occurrences of health issues (e.g., poor fitness or diabetes).

In addition to providing a clean and healthy natural environment for tribal members and other residents of the Umatilla Basin, improving the availability of First Foods can contribute to sustaining tribal ceremonies, knowledge, and traditions that promote the physical health of tribal members. Finally, the First Foods-focused mission provides resources managers in the basin with a framework for involving tribal members in management dialogues. Within such a framework, monitoring and restoration efforts can concentrate on improving the ecological functionality of the river, which ultimately sustains First Foods.

The content of this essay belongs solely to the authors. It does not necessarily reflect the opinions or decisions of the Water Resources Commission or the Water Resources Department.

Determining the Flows Needed to Support Instream Needs

This section looks at next steps for understanding base and elevated streamflows and for assessing groundwater-dependent ecosystems.

Fill in Knowledge Gaps – Instream Needs

Oregon's ability to meet instream needs is limited by our understanding of these needs. While scientists know that ecosystems and species depend upon both surface water and groundwater, they have not yet identified or quantified all of the ecological functions that rely on groundwater and surface water. Nor have they fully quantified the ecological degradation that occurs with differing qualities and quantities of water.

The Oregon Department of Fish and Wildlife, Department of Environmental Quality, and the Parks and Recreation Department are authorized to apply for instream water rights for specific purposes, such as protection of fish habitat, water quality, and scenic values. Such applications require scientific analysis and modeling to determine the base flows and elevated flows needed to support instream functions. This science allows the agencies to pursue appropriate instream water rights.

Instream water rights in Oregon today have been designed to address situations of low flow and they focus almost exclusively on depth, velocity, and substrate criteria. In general, instream water rights have not been issued to protect elevated streamflows.

Base Flow Studies. The State needs to identify which streams already have base flow needs studies completed, then prioritize and complete those that are still needed and those that require updates. Established methods already exist for these studies.

Recommended Action 3.A
Determine Flows Needed (Quality and Quantity) to Support Instream Needs

How to implement this action:

- Conduct base flow needs studies
- Develop elevated flow requirements
- Develop models/studies on economic value of instream and out-of-stream water 🕮

Elevated Flow Studies. More information is also needed regarding the elevated flows (peak and ecological flows) necessary to maintain the physical characteristics of a stream or to facilitate biological processes. The State can begin studies of elevated flow needs by developing criteria to determine what elevated flows are needed in each water basin/watershed. These include both biological triggering flows as well as channel habitat maintenance flows. The State should develop recommended flows for each water basin/watershed based on the developed criteria. Although the State has begun to develop methodologies in this area, information collection is still in the beginning stages.

Fill in the Knowledge Gap - Assessment of Groundwater-Dependent Ecosystems

Groundwater is a vital source of water that sustains both ecosystems and human communities worldwide. Wetlands, rivers, and lakes often receive discharge from groundwater; it provides late-summer flow for many rivers, and creates cool-water upwellings critical for aquatic species during the summer heat. The species and habitats that rely on this source of water for some or all of their life cycle are known as groundwater-dependent ecosystems, or GDEs. These ecosystems form the interface between groundwater and surface water, and due to their unique hydrology, they often harbor many rare and endemic species. A recent study found that 12 percent of species listed under the U.S. Endangered Species Act were groundwater-dependent species found in Oregon (Blevins and Aldous 2011).

Recommended Action 3.B
Determine Needs of Groundwater-Dependent Ecosystems

How to implement this action:

- Identify and characterize groundwater-dependent ecosystems statewide 🕮
- Complete groundwater basin studies

Oregon can start to identify and characterize groundwater-dependent ecosystems statewide by using a variety of available tools and methods, such as those developed by The Nature Conservancy and U.S. Forest Service. Tasks include determining which aquatic ecosystems are groundwater-dependent, mapping their occurrence across the landscape, and identifying their groundwater requirements for both water quantity and water quality. See accompanying essay for more information on groundwater-dependent ecosystems.

Allison Aldous and Leslie Bach,
The Nature Conservancy

Inventorying and Monitoring Groundwater-Dependent Ecosystems

Oregon has a wide distribution of groundwater-dependent ecosystems. Most are in basins such as the Deschutes, Klamath, John Day, and Willamette, as well as along the High Cascades both east and west of the crest. Oregon – with nearly 32,000 mapped springs – has the highest density of springs in the western United States (Stevens & Meretsky 2008).

English Sundew, an obligate wetland species

An obligate wetland plant species is almost always found growing in water or a water-saturated environment like a wetland (at least 99 percent of the time). English sundew and lesser bladderwort (see photos) are obligate wetland plants whose occurrence and survival are dependent on the water and nutrients provided in wetland habitats fed by springs.

As a major step toward protecting groundwater-dependent ecosystems like these, basin scale data collection and protocols are needed to provide more precise information about the location and character of groundwater-dependent ecosystems, as well as their requirements for a clean supply of groundwater.

Lesser Bladderwort, an obligate wetland plant

Some of this work is underway. The Nature Conservancy, working with the U.S. Forest Service, has been working on a series of methods and protocols for inventorying and monitoring groundwater-dependent ecosystems. This work can be done at the state-scale using readily available data (Brown et al. 2009; 2010), as well as at the basin scale (U.S. Forest Service 2012), and at the site scale (US Forest Service 2012). Because available data are often inadequate, results from the inventory and monitoring methods can be refined with remote sensing tools and techniques, such as imagery from the National Agriculture Imagery Program (NAIP) and Light Detection and Ranging (LiDAR).

Once the distribution of groundwater-dependent ecosystems is understood, the next important step is to quantify their groundwater quantity and quality requirements. This information can be used to balance the groundwater needs of people with those of ecosystems and species.

Recommended Actions at a Glance

Objective: Understand Instream and Out-of-Stream Needs	
Out-of-Stream Needs/Demands	2.A. Update long-term water demand forecasts 2.B. Improve water-use measurement and reporting 2.C. Determine pre-1909 water right claims 2.D. Update water right records with contact information 2.E. Update Oregon's water-related permitting guide
Instream Needs/Demands	3.A. Determine flows needed (quality and quantity) to support instream needs 3.B. Determine needs of groundwater-dependent ecosystems

CHAPTER 3

UNDERSTAND THE COMING PRESSURES THAT AFFECT OUR NEEDS AND SUPPLIES

Photo: USDA Forest Service

Water and Energy

Climate Change

Water and Land Use

Infrastructure

Education & Outreach

Oregon must anticipate and prepare for some of the most powerful changes that may affect both water resources and water needs into the future. The Oregon Legislature has expressed particular interest in preparing communities for the water-related implications of climate change, population growth, and changes in land use. The Strategy addresses these three issues, as well as the connection between energy and water, and the need to improve our water and wastewater infrastructure in response to anticipated pressures.

Education and outreach is another critical issue to consider as we plan for future instream and out-of stream water needs. The health and sustainability of Oregon's water resources, and the businesses and communities that depend on them, could benefit greatly from a variety of education and outreach efforts.

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City of Medford Wastewater Treatment Plant


Clean Water Services' LEED Certified Pump Station


Lacomb Irrigation District Turbine, Linn County

Photos: J. Gillaspie, Oregon ACWA; E. Teragli, Clean Water Services; G. Scholl-Erdmann, Farmers Conservation Alliance

In the United States, a tremendous amount of energy is used to deliver water to where it is needed. The amount of energy used to pump, treat, and heat water accounts for at least 13 percent of the nation's total electricity use, according to The River Network. Much of that electricity is used to heat water. According to the Oregon Department of Energy, heating water accounts for 15 to 25 percent of a typical home's energy bill.

The nexus between water and energy, in terms of producing and using each resource, has largely been unaddressed in water policy, studies, or planning activities in Oregon. With the Integrated Water Resources Strategy and new efforts to develop a 10-year Energy Action Plan, Oregon should take this opportunity to better connect the management of these two resources, and design a set of strategies where both resources are managed in an integrated and sustainable manner.

Energy Needs in the Water Industry

For a municipality, the energy costs for managing water and wastewater can represent one-third of the total energy bill. The U.S. Environmental Protection Agency estimates that U.S. drinking water and wastewater facilities spend about $4 billion annually on energy costs alone.

Some wastewater treatment facilities here in Oregon have been able to trim energy use with new pumps, drives, motors, and other energy efficient equipment with assistance from the Energy Trust of Oregon. Energy Trust has helped pay for a variety of renewable energy technologies that are highly cost-effective in wastewater facilities, including: converting methane (digester gas) to electricity using internal combustion engines, micro-turbines or fuel cells; or using fats, oils and grease to supplement digester gas; installing micro-hydroelectric power using a plant's outfall or flow of water; and using solar electric systems or small wind turbines.

Energy Trust's programs also offer technical assistance and help with feasibility analysis. Already, treatment plants in Washington County and the Cities of Pendleton, Mosier, Cottage Grove, and Portland have made money-saving energy gains by taking advantage of Energy Trust's programs. Oregon should continue these assistance programs, helping treatment plants move toward energy independence.

Water Needs in the Energy Industry

Just as we need energy in order to use water, we also need water to produce electricity. Natural gas and coal facilities require water for cooling purposes and bioenergy systems rely on water to grow fuel crops. Geothermal systems use groundwater as a medium for heat, while hydroelectric and wave energy facilities are powered by the movement of water.

In the Pacific Northwest, hydropower plays a prominent role in meeting our energy needs. According to the Northwest Power and Conservation Council, 40 percent of the electricity used in the Northwest is generated at federal hydropower dams in the Columbia River Basin. The federal Bonneville Power Administration, based in Portland, markets wholesale electrical power from federal dams in the Columbia River Basin.

According to the Oregon Department of Energy, 42 percent of the state's electric power mix in 2009 was sourced from hydropower facilities, federal or otherwise. By comparison, the second largest electricity resource consumed in Oregon is coal, at 34 percent.

The State of Oregon has adopted goals for the development of new electricity production from renewable resources. The 2007 Legislature created a Renewable Portfolio Standard (RPS) that requires the largest utilities in Oregon to provide 25 percent of their retail sales of electricity from newer, clean, renewable sources of energy by 2025.

Recommended Action 4.A
Analyze the Effects on Water from Energy Development Projects and Policies

How to implement this action:

- Analyze the water demands and water quality impacts of current and proposed water-intensive energy development projects (bio-energy, geothermal, solar, natural gas, and hydroelectric) 🕮

While some of these energy resources will not use water in a consumptive manner, the presence and availability of water is essential to their success. The development of renewable power systems in order to achieve a cleaner energy mix and new economic opportunities brings with it as-yet-unquantified demands for water. An analysis of demands for water intensive energy-development projects and policies in each energy sector is needed. It would provide a better scientific understanding of the state's future water commitments.

Expanding Oregon's Hydroelectric Portfolio

New hydroelectric projects will likely be part of the new resources developed as part of the State's Renewable Portfolio Standard. According to the State of Oregon's 2011-2013 Energy Plan, new growth in the hydropower sector is most likely to occur in three areas: pumped storage; the addition of power facilities on existing dams; and the addition of power within existing irrigation systems.

Pumped Storage Systems

A pumped storage system consists of two reservoirs, one at a higher elevation than the other, in which water moves down to the lower reservoir to generate power when demands are high; and then water is pumped back up to the higher reservoir when prices and demands are low, usually at night. Pumped storage systems are not considered to be a renewable power source. In fact, they operate at a net power loss.

Because of the balancing services pumped storage systems provide to the grid, they can be considered both a power management tool and an energy storage device. These plants can operate at any size, but most proposals are very large—around 1,000 megawatts (MW). By comparison, Bonneville Dam on the Columbia River has a capacity of 1,189 MW. There are several proposals for pumped storage, but no developed projects yet in Oregon. The proposals are located near high-voltage transmission or existing water infrastructure.

Hydroelectric Development

The economics of energy has stimulated large water users and private developers to consider opportunities for adding hydroelectric projects to existing infrastructure.

Incentive programs and policy initiatives have enhanced the ability for projects that do not have new impacts to other natural resources to be developed more quickly, as compared to larger hydropower projects that may have an impact on natural streams or waterways.

The Northwest Power and Conservation Council's Fish and Wildlife Plan discourages new hydropower development on many streams in the Northwest, unless the project can be developed at an existing diversion or within the infrastructure beyond the diversion.

Recommended Action 4.B
Take Advantage of Existing Infrastructure to Develop Hydroelectric Power

How to implement this action:

- Utilize the state's expedited application process to develop hydroelectric projects at existing infrastructure

The Federal Energy Regulatory Commission (FERC) is the major federal agency responsible for balancing energy needs and the protection of natural resources for major hydroelectric projects. FERC authorizes two types of exemptions that can be approved in a much shorter time frame than a standard license: "exemption" projects added to an existing dam structure with a capacity of five megawatts or less; and "conduit exemptions." Conduit exemptions are power generation projects that occur within or at the end of a pipeline or conduit beyond the original diversion. A conduit may be an open canal or a pipeline in an irrigation district, a pipeline in a municipal water or wastewater system, or a pipeline within an industrial operation.

Oregon has an expedited review process for new hydroelectric projects at existing infrastructure. The amount and timing of water diverted for an existing water use must remain unchanged (ORS 543.765). Holders of water right certificates under these provisions can secure approval to install hydroelectric generation inside or at the end of existing transmission pipelines or conduits. The resulting hydroelectric water right certificate will include the Oregon Department of Fish and Wildlife's requirements for fish screens, by-pass devices, and fish passage.

Oregon's review process for standard hydroelectric projects is thorough and complex. The multi-stage process provides for a preliminary permit to reserve a project site while environmental and cultural studies are conducted to assess the impacts of a project and to identify measures to mitigate those impacts. The review includes an assessment of the potential for cumulative impacts with other existing or proposed hydroelectric projects within the same river basin. It also includes an assessment of the public interest issues of the project. A contested case hearing is required for these major projects and the general public is offered an opportunity to provide oral comments at the hearing.

Oregon's existing water infrastructure—its dams and delivery systems—are already being utilized for energy development. Water users should continue exploring options for adding power generation facilities to existing infrastructure, while adhering to existing environmental protections.

Kevin Crew,
Black Rock Consulting

Conduit Hydroelectric Projects in Central Oregon

Most of the hydropower projects in the irrigation districts of Central Oregon have placed conserved water instream as the result of converting leaky, open canals into closed pipes. The districts have permanently placed 40 cubic feet per second (cfs) of senior water instream—through the State's Allocation of Conserved Water Program—in exchange for public funding to help purchase pipe. Examples include:

- Central Oregon Irrigation District recently completed a 3.8 MW Juniper Ridge Hydroelectric Power Generation Facility, which began full power production in 2011.

- Swalley Irrigation District installed a 0.75 Megawatt hydroelectric power plant located in Central Oregon near Bend.

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- The Blue Lake (Camp Caldera) Hydropower Site features a 20 horsepower project with Fish Screening and Passage Design. This unique project involves a fish screen that meets the State's passive cleaning criteria. Fish passage at the project utilizes a unique stainless steel design developed using the insight of renowned sculptor, Lee Kelly. The project has won several engineering excellence awards both in Oregon and nationally and has presented a viable alternative to traditional concrete ladders.

Blue Lake Hydropower Site with Fish Passage and Screening

Gaining Water and Energy Savings

The Alliance for Water Efficiency and the American Council for an Energy Efficient Economy recently published a "blueprint for action," identifying ways to gain efficiencies in both water use and energy use. For the past 30 years, strategies to conserve energy and increase the efficiency of water use have been widely pursued. However, until now, efforts to save water and energy have historically not worked together in a coherent, collaborative manner. Instead, separate but parallel efforts exist. Significant savings could be realized from coordinating water conservation and energy conservation efforts.

Saving Water and Energy through Building Codes

New building construction or remodeling existing facilities is a great opportunity to integrate water and energy conservation into the design process. Oregon has statewide mandatory building codes in 11 different specialty areas, including plumbing and energy. The codes are based on national model codes and are updated on three-year cycles. They establish minimum requirements for all commercial and residential construction in the state.

To provide guidance to local jurisdictions on water conservation, the State of Oregon Building Codes Division (BCD) approved Statewide Alternative Methods (SAMs) for rainwater harvesting (applicable to both commercial and residential construction as well as potable and non-potable uses) and for the use of graywater for toilet flushing. The Division also published a series of *Oregon Smart Guides* for consumers, two of which focus on rainwater harvesting and water conservation systems.

The Building Codes Division recently finalized two new building codes, known as the Oregon Residential Reach Code and the Oregon Commercial Reach Code, that offer an optional set of construction standards for achieving greater energy efficiency in buildings that are newly constructed, reconstructed, altered or repaired for residential and commercial buildings. Because pumping and treating water and wastewater can require a significant amount of energy, BCD opted to include water conservation measures in the Reach Code.

Oregon should continue to implement and evaluate building codes to further improve water and energy efficiencies.

Saving Water and Energy in Agriculture

Agricultural producers in Oregon are usually looking for ways to save on water and energy-related costs. The 2011 Industry Report from the Oregon Board of Agriculture describes an upward trend in the number of Oregon producers adopting changes resulting in energy and cost savings. Nearly 5,000 Oregon farms reported making changes in the past five years to their equipment or management practices that reduced energy use or conserved water. Although there is no published state-level inventory of agricultural electrical consumption by kilowatt-hour, Oregon growers reported about $49 million for electricity costs in 2008 related to pumping irrigation water. The water came from about 21,000 pumps serving approximately 1.8 million acres.

Many of Oregon's farmers and ranchers have implemented energy efficiency projects, and a few have implemented renewable energy projects. Some of the most attractive projects are those that provide significant co-benefits, such as labor savings, water savings, and improved soil productivity. Irrigation efficiency and reduced or no till cropping systems were the most popular types of energy efficiency projects among farmers/ranchers who responded to a 2010 ODA survey. Efficiency projects included use of efficient water application equipment, energy-savings pumps and motors, soil moisture monitoring programs, reduced tillage or no-till cropping systems, precision fertilizer application, and installation of more efficient lighting systems.

Recommended Action 4.C
Promote Strategies That Increase/ Integrate Energy and Water Savings

How to implement this action:

- Move toward energy independence for publicly operated treatment works (wastewater treatment)
- Encourage communities to look for and integrate ways to conserve both energy and water 🕮
- Continue to implement and evaluate building codes that encourage water and energy efficiencies
- Ensure that efficiency programs capture and publicly report both water and energy savings data 🕮
- Partner with Oregon's 10-year Energy Action Plan to promote conservation strategies for water and energy

Achieving greater efficiencies in water application—for example, moving from flood irrigation to drip irrigation—may simultaneously increase the demand for energy and may drive up energy costs. This tradeoff of increased energy use may outweigh the water-use efficiency benefits, and should be considered during the design of a project, especially for non-pressurized water systems.

Many agricultural-related energy programs are driven primarily by energy efficiency goals, such Energy Trust's irrigation efficiency incentives, and the *Save Water, Save Energy* program offered by some BPA-affiliated energy providers. Likewise, water programs typically highlight the benefits of water conservation for fish and instream flows. Oregon should look for ways to integrate energy-efficiency and water savings programs within agriculture and across other water sectors, and capture the results of project efforts. Integrating these programs can lead to more wide-ranging benefits, help eliminate unintended consequences, and provide better information for the design of such programs in the future.

Saving Water and Energy in the Home

Energy Star, a joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy rates energy efficient products and practices to help consumers and businesses save money and energy on new purchases. Many qualifying appliances also reduce water use. A full-sized Energy Star clothes washer, for example, uses 14 gallons of water per load, compared to the 27 gallons used by a standard machine. This can result in a savings of 43,000 gallons of water over the machine's lifetime.

The Energy Trust of Oregon offers a number of cash incentives for participating customers of Portland General Electric, Pacific Power, NW Natural, and Cascade Natural Gas. The cash incentives are wide-ranging, with benefits for residences, businesses, industries, and agriculture. The Energy Trust promotes Energy Star products as well, offering cash back on premium-efficiency qualifying clothes washers.

The Oregon Department of Energy also offers residential energy tax credits statewide, allowing Oregonians to claim a credit for energy efficient upgrades in their homes. The state tax credit is available for premium energy-efficient water heating technologies, such as tankless, heat pump, and solar water heaters.

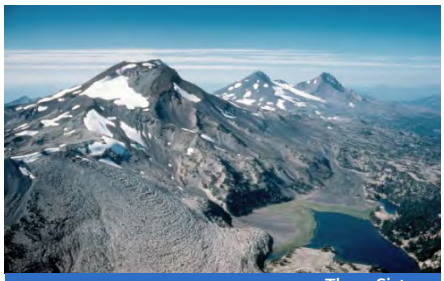
Several of Oregon's water providers also offer water saving incentive programs to their customers. In recent years, water providers in the Portland metropolitan area have partnered with the Energy Trust and Portland General Electric to offer co-audits that identify both water and energy savings.

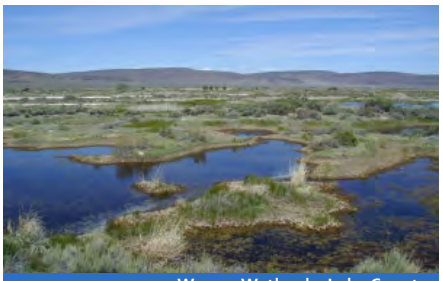
Strengthening Coordination and Partnerships

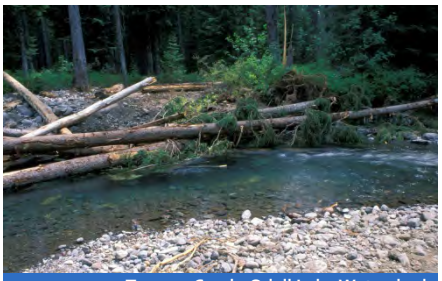
Undoubtedly, there are very good reasons to consider the relationship between water and energy. Water has played a key part in meeting our energy demands in the Pacific Northwest, and may play an even greater role as we look to renewable energy and other technologies to meets our needs in the future. The importance of the state's water resources for meeting often competing needs makes it even more imperative to consider how energy development affects our demands for water.

Addressing the water and energy nexus cannot be focused on only one sector. We all depend on water and energy, and we can all contribute to making more efficient use of both. Oregon's state agencies and partners should focus efforts on strengthening the coordination between water and energy conservation programs. Developing new partnerships with water users to identify and promote optimal combinations of on-site water and energy efficiencies will be necessary to advance statewide conservation efforts.

CRITICAL ISSUE: CLIMATE CHANGE


Three Sisters


Warner Wetlands, Lake County


Trapper Creek, Odell Lake Watershed

Photos: USGS, BLM, USFS

The consensus among climate scientists is that climate shift is occurring and that significant impacts to the environment will be felt in this century. An analysis of the global climate models used in the 2007 Intergovernmental Panel on Climate Change assessment show an increase in annual average air temperatures in the Pacific Northwest through the end of the 21st century.

An increase in average air temperatures has potential consequences for Oregon's water resources. Oregon's wetlands, estuaries, rivers, and streams—even groundwater—are all affected by changes in climate. Oregon's forest ecosystems, essential for storing and filtering water, will also be affected by climate change. These changes will have implications for our ability to meet instream and out-of-stream water needs. Oregon will need to continuously monitor climate change effects on Oregon's water resources and help water users adapt to climate change.

Climate Change Research and Partnerships in Oregon

Many institutions at the local, state, and federal level are conducting climate change research, identifying and assessing risks and actions specific to the Pacific Northwest. Many of Oregon's drainage basins have been the focus of these latest research efforts. In 2010, for example, teams of university researchers began evaluating how climate change, population growth, and economic growth will alter the availability and the use of water in the Willamette River Basin on a decadal to centennial timescale. This research will help water managers and natural resource agencies develop placed-based strategies for addressing climate-related impacts on water quality, water quantity, and ecosystems. Today, there are many opportunities for further collaboration between government agencies and research institutions.

Oregon Climate Change Research Institute

The Oregon Climate Change Research Institute (OCCRI) has been tasked by the Oregon Legislature to foster climate change research among faculty of the Oregon University System. In 2010, OCCRI released the *Oregon Climate Assessment Report*, a compendium of research on climate change and its impacts on the state of Oregon. The report draws upon a large body of work on climate change impacts in the western United States, including work conducted by the Climate Impacts Group at the University of Washington, and the California Climate Action Team. The report also identifies several knowledge gaps and the need for more research in certain areas.

Researchers are also examining climate change impacts on a regional scale, looking specifically at risks to the Pacific Northwest. The National Oceanic and Atmospheric Association awarded a five-year grant to establish and coordinate a regional consortium of climate variability assessment, research, and outreach in the Pacific Northwest. Funds were used to establish the Climate Impacts Research Consortium (CIRC), which includes OCCRI and other researchers from universities and extension services within Oregon, Washington, and Idaho. The Consortium provides information and tools for making decisions about landscape and watershed management in a changing climate. CIRC expects funding of $3.8 million to continue climate change research over the next five years. CIRC has been home of the Regional Integrated Sciences and Assessments (RISA) for the Pacific Northwest since September 2010, one of eleven currently funded RISAs in the country.

Recommended Action 5.A
Support Continued Basin-Scale Climate Change Research Efforts

How to implement this action:

- Improve climate change projections at a basin scale 🕮
- Develop reliable projections of basin-scale hydrology, and their impacts on other systems 🕮

Oregon's Climate Change Adaptation Framework

The Oregon Department of Land Conservation and Development recently led an interagency effort to develop the *Climate Change Adaptation Framework* for the State of Oregon. The Framework provides 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. The Framework was developed in parallel with OCCRI's *Oregon Climate Assessment Report* and provides initial recommendations for preparing for the likely impacts of climate change, including planned and needed actions by state agencies. The Framework describes eleven likely changes in climate conditions in Oregon over the next three to five decades.

Oregon Global Warming Commission

The Oregon Global Warming Commission's general charge is to recommend ways to coordinate state and local efforts to reduce Oregon's greenhouse gas emissions consistent with Oregon's reduction goals, and to recommend efforts to help the state, local governments, businesses and residents prepare for the effects of global warming. In 2010, the Oregon Global Warming Commission began its Roadmap to 2020

Project. It will offer recommendations for how Oregon can meet its goal of cutting greenhouse gases by 10 percent below 1990 levels by 2020, and achieve a minimum of 75 percent reduction from 1990 levels by 2050. A key action for the Roadmap is to increase water efficiency, because water use is an important component of many industrial processes and should play a part of Oregon's greenhouse gas emissions reduction strategy.

Climate Change Projections for Oregon

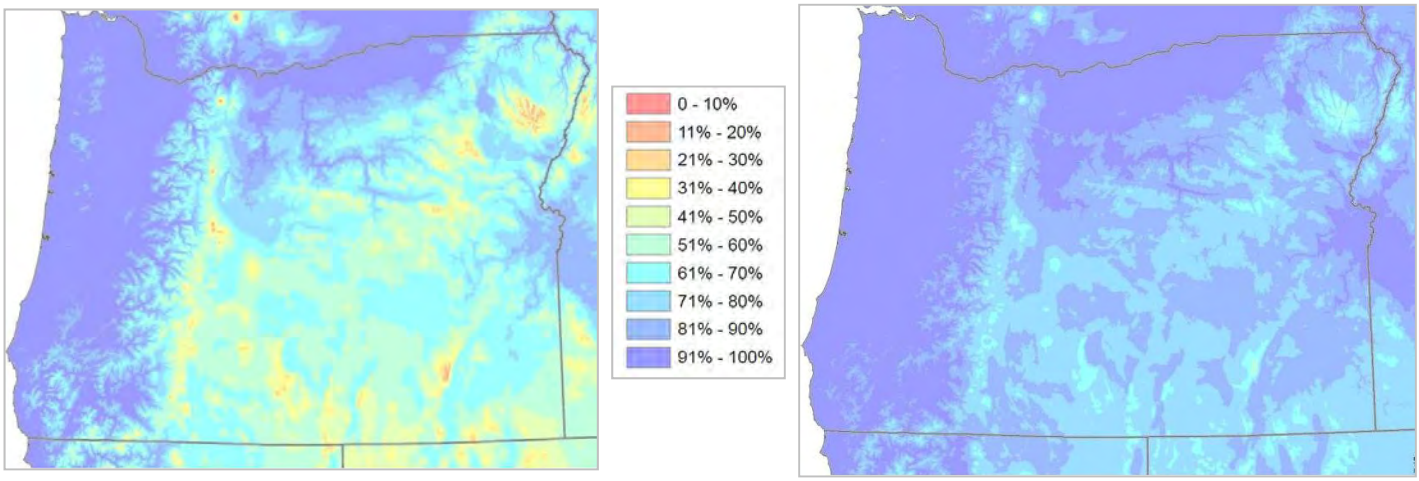
Many of the likely changes (or risks) that are predicted will affect water resources. Climate change will likely alter the hydrology of many streams throughout Oregon, affecting the availability and quality of water. Increasing temperatures will affect snowpack in the Cascades, which will alter the timing of runoff and water availability in large areas of the state. Following is a summary of some of the risks identified in the *Climate Change Adaptation Framework*, OCCRI's *Assessment*, and other recent studies.

Declining Springtime Snowpack

Climate models project an average rate of warming of approximately 0.1 – 0.6° Celsius per decade through the 2050s. The rate of change after the 2050s depends increasingly on the choice of greenhouse gas emissions scenarios.

If Oregon's mean annual temperature increases, the percentage of precipitation that falls as snow will be significantly less. The accompanying figures show the percentage of precipitation that falls as rain in two scenarios: current precipitation conditions and conditions with a rise in temperature of 3.0° Celsius.

Current Precipitation Conditions



Future Scenario (3.0°C Temp Increase)

Red, yellow, and orange hues represent areas where a large percentage of precipitation falls as snow.

Snow-dominant areas largely disappear with a rise in air temperature.

Significant declines in snow water equivalent in the Pacific Northwest and a shift in precipitation from snow to rain coinciding with increases in air temperature since the 1950s are well documented. Precipitation arriving as rain instead of snow could pose several challenges to water systems, such as flashier flood-prone systems, decreased summertime run-off to surface water, and reduced recharge to groundwater aquifers. Water users who are dependent on snowpack for summertime water could see significant decreases in water when they need it most.

Oregon, like much of the Northwest, is highly dependent on temperature-sensitive springtime snowpack to meet growing and often competing water demands. A study completed by the Climate Impacts Group at the University of Washington indicates that approximately 50 percent of Oregon water users are located in areas of the state that are dependent on snowpack to meet their water needs.

This means that water availability significantly depends on the presence of natural storage, with water becoming available during heavy use periods as a result of snow melt. Loss of natural storage means less water will be available to meet instream and out-of-stream needs during summer and fall months. This issue will be compounded by the potential for warmer summer months and a longer growing season.

Storing water, via built and natural systems, is important for meeting Oregon's water needs. More work is needed to understand how the loss of natural storage can be mitigated through structural and non-structural approaches.

Increased Incidence of Drought

Drought has historically been an issue in Oregon largely because precipitation in the Pacific Northwest is highly seasonal. The Pacific Northwest is prone to three types of drought: low winter precipitation, low summer precipitation and lack of snowpack due to warm winter temperatures. A 2002 statewide hazard analysis found six counties—Harney, Jefferson, Klamath, Sherman, Wallowa, and Wheeler —ranking drought as their "number one" natural hazard concern. Gilliam County also ranked it highly.

When drought conditions exist, the Governor can issue a formal drought declaration, which triggers a number of water management tools to which users would not otherwise have access. The declaration allows water users to apply for emergency permits under an expedited process, temporary transfers, and temporary substitutions of a supplemental groundwater right for a primary surface water right. A drought declaration also allows the Water Resources Commission to grant a temporary preference of use for human consumption and/or stock watering. The Commission may also order state agencies and local governments to develop and file Conservation and Curtailment Plans with the Water Resources Department.

Due to the annual variability of precipitation in the Northwest, not all droughts can be attributed to climate change. However, with more winter rainfall, declining snowpack, and earlier spring snowmelt as a result of increasing air temperatures, drought conditions are likely to increase throughout the next century.

The possibility of drought, and longer and drier growing seasons, could result in an increased demand on groundwater resources and increased consumption of water for irrigation. With a 1° Celsius rise in temperature, irrigation demands are projected to increase by 10 percent. An increase in irrigation-related water consumption can translate into higher irrigation costs. The economic impact of more frequent drought conditions may negatively affect the agriculture industry, as farmers see reduced yields and quality in some crops.

Determining how water rights for irrigation will fare with changing crop needs and growing seasons under various climate change scenarios is needed. Updating Oregon's crop water use tables, published in 1992, and used by water managers and consultants throughout the state for designing irrigation systems/scheduling, water right transfers, and other studies may be needed to help better prepare agricultural water users for the impacts of climate change.

More Frequent Precipitation Events and Flooding

Floods are a common and widespread natural hazard in Oregon. Floods west of the Cascades tend to be associated with larger scale, more widespread events, while eastern Oregon typically experiences more localized, intensive events.

The National Flood Insurance Program reports that 256 communities in Oregon are prone to flooding, in all 36 counties. Oregon has seen the damaging effects of severe winter storms and resulting floods as recently as January 2012, with a major disaster declaration issued for twelve counties in Oregon.

There is confidence that flooding will increase in the 21st century, particularly in areas that have a history of chronic flooding. Flooding in Oregon generally occurs due to extreme precipitation events, rapid snowmelt, or rain-on-snow precipitation events. In the next few decades, extreme daily precipitation events may increase, but exact locations cannot be predicted with certainty.

Increasing Wave Heights, Storm Surges, and Sea-Level Rise

The coast is vulnerable to a number of climate-related impacts, which will exacerbate many of the stresses and hazards facing the Oregon coastal zone. Oregon's winter storms have historically been the primary factor for coastal erosion and flooding. Maximum wave heights have increased significantly from the period of the late 1970s to 2005, from 9 meters to about 12 meters. The combination of the likely possibility of increasing storm-generated wave heights and rising sea-levels may present a substantial threat to the Oregon Coast.

Such threats include increased erosion and the loss of beaches and significant coastal land areas. Other threats include increasingly stressed infrastructure facilities built under older engineering standards. Infrastructure at risk can include water treatment plants, diversion facilities, and wastewater plants. The intrusion of salt water to such facilities will be a risk in some coastal communities.

Sea-level rise will also have impacts beyond coastal Oregon, affecting tidally-influenced rivers, such as the Willamette, and surrounding inland communities, where rising river levels can pose flooding problems.

Oregon will need to ensure that it is capable of providing water and wastewater services in the face of a changing climate. This can be done by making water systems more resilient by improving storage and transmission capacity, building in system redundancy (back-up supplies, intergovernmental agreements), and further pursuing water conservation, reuse, and efficiency projects in partnership with neighboring communities.

Stacy Vynne and Roger Hamilton, The Resource Innovation Group

Willamette Valley Resilience Compact: Enhancing Climate Change Coordination among Local Governments

Local jurisdictions across the Willamette Valley are coming together to develop a Willamette Valley Resilience Compact among city and county governments. The purpose of the Compact is to coordinate and enhance efforts to build the resilience of the Valley's economy, public health, food, water, and energy supplies, in the face of natural hazards and anticipated impacts from a changing climate. The Compact is a cooperative approach led by local governments, but which engages state and federal agencies, stakeholders from the private sector, and non-governmental organizations in order to strengthen community and regional resilience to build a sustainable future for the entire Willamette Valley. The Resource Innovation Group, a nonprofit organization based in Eugene, is facilitating this process. City and county governments plan to move the Compact forward for adoption in late 2012.

Climate Change and Ecosystems

Climate change projections show negative consequences for Oregon's ecosystems. As such, Oregon will need to support efforts to improve the resiliency of its diverse ecosystems in response to climate change.

Fortunately, much work has already been done to increase the resiliency of Oregon's natural environment, through local restoration efforts under the Oregon Plan for Salmon and Watersheds and other habitat restoration and conservation programs. Protecting and restoring streamflows, wetlands and floodplains, and improving riparian zones, uplands, and forests are efforts that should be continued and strengthened.

Loss of Wetland Ecosystems

Sufficient scientific evidence suggests that climate change is now having and will have significant impacts on millions of coastal, estuarine, and freshwater wetlands throughout the United States due to increased temperatures, changes in precipitation, and sea-level rise. Sea-level rise predictions for Oregon wetland refuges indicate different types of impacts across different estuaries or estuarine segments.

Wetlands are more sensitive to small changes in precipitation and temperature than other ecosystems and thus may be degraded or lost as a result of future climate conditions. Depending on the sea-level rise scenario, analyses indicate that Bandon Marsh National Wildlife Refuge is predicted to lose between 19 and 92 percent of its swamp by 2100.

Effects on Forest Ecosystems

A recent U.S. Forest Service report describes how warmer temperatures and changing water quantities can heighten changes in forest vegetation and forest mortality. Higher summer temperatures and earlier spring snowmelt are expected to increase the risk of forest fires. An increase of insect outbreaks, wildfires, and changing species composition in forests will pose challenges for ecosystems and significant challenges for water management.

Effects on Aquatic Species & Habitat

The distribution of cold-water species will potentially shrink and become disconnected as thermal regimes in river networks warm. Climate change projections show that 37 percent of the current locations of 57 North American freshwater fish species would not support these species over the next century.

Other studies show trout habitat in the Pacific Northwest declining between 8 and 33 percent by 2090. Salmon is even more vulnerable to the effects of climate change because more of its habitat is located at lower, warmer elevations. Projections show that suitable salmon habitat in Oregon and Idaho may shrink as much as 40 percent by 2090.

Climate Change and Water Quality

Climate change impacts to our built and natural systems will be compounded by the water quality issues we are already facing in Oregon. High water temperatures are already a major water quality concern in more than 17,000 miles of Oregon's streams and rivers today. Water temperature is projected to rise as air temperature increases in the 21st century, particularly in urban streams where natural riparian vegetation is typically lacking. A decline in summer streamflow will exacerbate the increase in water temperature, because low volumes of water can heat up more quickly than during periods with larger streamflows.

In snowmelt-dominated watersheds, increases in runoff will result in warmer summer water temperatures, increased pollution, and sedimentation, all of which have negative consequences for natural systems, salmonids, and other estuarine and marine populations.

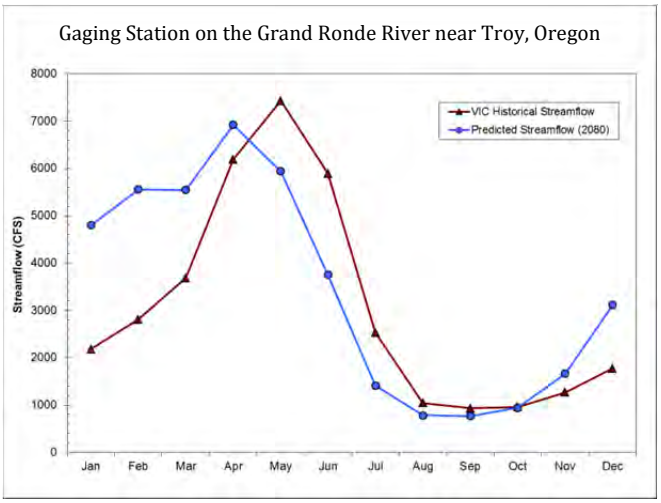
The water quality effects of climate change not only affect our natural systems, but can also affect our built systems as well. Increased runoff, storm events, and sedimentation can further impair water quality, and may overwhelm drinking water and wastewater treatment facilities, possibility leading to increases in pollution and higher treatment costs. The Climate Ready Water Utilities Program at the U.S. Environmental Protection Agency is a resource that can help water providers develop and implement long-range plans that account for climate change impacts. Water providers in Oregon should consider use of this program to prepare for climate change.

Climate Change and Water Quantity

The change in timing and availability of water as a result of climate change may affect whether or not water users are able to utilize their water rights as authorized. It could also mean that instream water rights are not met as often in the future.

The scenario at the right demonstrates how dramatically the hydrograph (a depiction of streamflow) could shift in one stream, due to a loss in snowpack. Where snowmelt historically resulted in high flows from April to June, future precipitation in the form of rain may instead result in high flows from March through May.

The implications of this shift could be significant for water right holders, particularly for those who have historically relied on surface water during June, July, August, or September.



For an explanation of the climate scenarios used, visit the Climate Impacts Group site at: www.hydro.washington.edu

Water rights that protect water instream for a certain amount, time of year, and location may no longer be adequate due to precipitation changes, decreased snowpack, and changes in species distribution. An increase in regulation to meet senior out-of-stream water rights, to protect instream needs, and to meet water quality needs could result.

Water managers and water users will need to look for more efficient ways to conserve, store, and reuse water, while also considering innovative alternatives or new ways to meet needs in a changing climate, especially during times of critical low-flow periods. Future efforts should include an analysis of how instream and out-of-stream water rights would fare with significant hydrologic changes. Analyzing the potential local effects of climate change will help planners build alternatives into place-based, integrated, water planning efforts.

Supporting Climate Change Research and Adaptation Strategies

Oregon should continue collaborating with existing climate change research organizations and institutions to improve climate change projections at a basin scale. Basin-scale data is needed to help Oregonians begin preparing responses and strategies to address climate change.

Collaboration includes working with the Oregon Climate Change Research Institute and Pacific Northwest Climate Impacts Research Consortium on basin-specific studies. Oregon's natural resource agencies at the local, state, and federal level should invest and make improvements in the long-term monitoring of surface water and groundwater resources, including the NRCS's SNOTEL network. Investments are also needed to improve the real-time forecasting of water deliveries, basin yields, monthly streamflow, flood frequency projections, and drought frequency projections.

Oregon needs to develop reliable climate change projections for hydrology at a basin scale, and determine the associated impacts to built and natural systems, such as:

Recommended Action 5.B
Assist with Climate Change Adaptation and Resiliency Strategies

How to implement this action:

- Provide support to communities to incorporate climate change into their planning decisions 🕮
- Look for more efficient ways to conserve, store, and reuse water in anticipation of climate change
- Invest and make improvements in surface water and groundwater monitoring
- Invest in real-time forecasting of water deliveries, basin yield, streamflow, flood and drought frequency projections
- Analyze how instream and out-of-stream water rights will fare with hydrologic changes
- Analyze how water rights will fare with changing crop needs 🕮
- Use the U.S. Environmental Protection Agency's Climate Ready Water Utilities Program
- Increase ecosystem resiliency to climate change
- Ensure continued water and wastewater services in a changing climate

- the flooding potential with precipitation arriving as rain instead of snow;
- the effects on groundwater recharge from loss of snowpack;
- changes in timing and streamflow as well as potential impacts to water quality;
- the impacts on various life stages of aquatic species, including species abundance and distribution;
- changes in municipal and agricultural demand, shifts in water-related infrastructure needs (e.g., treatment, storage, transmission); and
- the impacts on wetland and floodplain restoration efforts.


Catherine Creek State Park, Union County


Harney County


Santiam State Forest

Photos: Gary Halvorson, Oregon State Archives, Oregon Dept. of Forestry

Land and water are connected in many ways. The way in which we manage the landscape—our forests, farmlands, rangelands, and urban spaces—can have positive or negative implications for water resources. Protections have been put into place to ensure that streams, rivers, and groundwater resources are managed for the long-term sustainability of Oregon's ecosystems, economy, and quality of life. Proper land management can play a critical role in the health and availability of water resources for future generations.

Local government land use planners do not always have the information they need to make long-term decisions that affect water resources. Oregon can help remedy this issue by improving communication and coordination between state and local governments on land use matters and water resources. Considering the pressures of projected increases in population, Oregon's communities need to adequately plan and prepare for meeting a larger demand on a shared resource. Water quality, water quantity, and ecosystems will all need to be considered within the context of land management and development. Efforts that are aimed at minimizing the impact of development can help meet statewide goals related to protection and use of water resources.

Planning for Land Use in Oregon

Oregon's statewide land use planning program was designed to foster livable and sustainable development; to protect farms, forestlands and other natural resources; to conserve coastal and ocean resources; and to improve the well-being and prosperity of Oregon's citizens, businesses, and communities. Originating in 1973 under Senate Bill 100, the program has positioned Oregon as a nationally recognized leader in the arena of land conservation and development.

Land use management is a function that resides with local planners, local planning commissions, boards, and councils, all of which include a public process and oversight from the state Department of Land Conservation and Development.

Local governments in Oregon are responsible for implementing their own Comprehensive Land Use Plan that complies with the 19 statewide planning goals. The Land Conservation and Development Commission will acknowledge a local government's comprehensive plan when it complies with the goals. Many of these planning goals relate to protecting and maintaining water resources, both quality and quantity.

- **Goal 5** requires protection of state-designated areas with known water supply or water quality issues, along with protection of wetlands and significant riparian corridors. Specifically, Goal 5 and its administrative rules require local governments to protect "significant natural resources." These include 1) critical groundwater areas and restrictively classified areas designated by the Oregon Water Resources Commission,

and 2) certain wellhead protection areas. Few local governments have completed this planning, particularly since completing the process for wellhead protection areas is not mandatory.

- **Goal 6** is aimed at maintaining and improving the quality of the air, water, and land resources of the state. This goal has no implementing rules. Although the goal directs local governments to consider the effects of land use on water quality, it does not contain specific requirements on how to achieve this aim.

- **Goal 11** and its administrative rules require cities with a population greater than 2,500 to prepare public facilities plans addressing drinking water, wastewater disposal and treatment, and stormwater management needs. These plans focus on the costs and timing of infrastructure needs and coordination among providers within the jurisdiction.

The 19 Statewide Planning Goals

Goal 1	Citizen Involvement
Goal 2	Land Use Planning
Goal 3	Agricultural Lands
Goal 4	Forest Lands
Goal 5	Natural Resources, Scenic and Historic Areas, & Open Spaces
Goal 6	Air, Water and Land Resources Quality
Goal 7	Areas Subject to Natural Hazards
Goal 8	Recreational Needs
Goal 9	Economic Development
Goal 10	Housing
Goal 11	Public Facilities and Services
Goal 12	Transportation
Goal 13	Energy Conservation
Goal 14	Urbanization
Goal 15	Willamette River Greenway
Goal 16	Estuarine Resources
Goal 17	Coastal Shorelands
Goal 18	Beaches and Dunes
Goal 19	Ocean Resources

There are also other goals that indirectly affect water resources, such as development restrictions on forestlands and agricultural lands. Development on forestlands is limited by Goal 4 and by county regulations. Forests encompass a large part of many watersheds, particularly in the upper reaches. Limiting land uses that could have a detrimental effect on water quality is one of the purposes of restrictive forest zoning.

Water and Changes in Land Use and Plans

Changes in land use, whether to forestlands, wetlands, or other landscapes have an impact on water resources. For example, Oregon's forests are a source of high quality drinking water and directly support public drinking water systems and ecosystem health. Changes within the forested landscape may decrease the quality of this water, which is among the best source water in the nation today. Like forestlands, Oregon's 17.1 million acres of agricultural lands, have been preserved by Oregon's land use planning system, helping to keep Oregon one of the most agriculturally diverse states in the nation.

Urbanization and significant new rural development on what was formerly farm or forestland may result in increased consumptive use of water, while at the same time altering the stormwater regime and contributing to nonpoint source pollution. Local development regulations created in response to the Clean Water Act and Goal 6 help address runoff and other quality concerns. Finding and maintaining high quality drinking water sources are increasing challenges for municipalities and for rural land owners in some areas of the state.

Planning for Growth

Continuing to protect natural resources will become even more important and challenging with expected population growth in Oregon. Some areas that are seeing a growth in population are also areas with known water resources issues. Many of the state's groundwater restricted areas fall within portions of Marion, Polk, Yamhill, Washington, and Clackamas counties, all of which saw a population increase of at least 10 percent since 2000.

Deschutes County is another area where population has grown steadily. Growing from a population of about 62,000 in 1980, Deschutes County is now home to nearly 158,000 people. Many residents live within the upper Deschutes Basin where future groundwater use has been limited to protect existing water uses, including scenic waterway flows and instream water rights. Planning for future development must take into account current pressures on Oregon's water resources, in terms of both water quantity and water quality.

Each city and metropolitan area in Oregon has an urban growth boundary that separates urban land from rural land. The boundary controls urban expansion onto farm and forestlands. By law, every city has to maintain a long-term supply of buildable land in its UGB to accommodate growth. In the Portland area, Metro is the responsible governing body and in 2011, for example, Metro added 1,985 acres to the UGB to help address the anticipated 20-year need for new housing and jobs. Medford and Bend are among the cities currently updating and expanding their urban growth boundaries. Over the next 50 years, urban and rural transition zones may become areas where the availability and quality of water resources play a more important role during the planning process.

Information Used in Land Use Planning

Considering the need to comply with several, very different land use goals, the information needed and used to develop land use plans covers a wide spectrum. Oregon Department of Forestry's stream classification maps, Oregon Department of Fish and Wildlife's fish presence surveys, Local Wetland Inventories, the National Wetland Inventory, and the Federal Emergency Management Agency's floodplain maps are often used by land use planners to develop local riparian corridor and wetland protections.

Some local governments use Drinking Water Source Area maps and Source Water Assessment Reports (when available) to voluntarily initiate a process to protect drinking water sources. Population and employment forecasts are of interest to municipalities when estimating demand for residential, industrial and other sectors.

Studies conducted to support individual land use requests, particularly to show that there is an adequate supply of water for a proposed rural use, are frequently completed. These customized studies are usually based on existing data such as well logs, basin studies, and previous reports.

Finally, Oregon's land use laws provide opportunities for counties to consider the appropriate level of rural development in areas that are not zoned for "resource" (i.e., farm or forest) use and to study whether new areas for development should be designated. The planning goals require counties to address the carrying capacity of the land when considering how much development, particularly of residential use, is appropriate. Developments in most rural areas of the state depend on groundwater to supply residential needs. Counties need data on the availability of groundwater in order to make informed decisions on what density of development to permit in rural development zones.

There are areas, however, where data is lacking and improvements could be made to connect land use planning and water resources planning. Of chief concern, local land use decision makers need more information about groundwater availability at specific locations, as well as the long-term ability of local aquifers to yield water, when making decisions about appropriate locations for development, particularly in rural areas. Available groundwater information today tends to be either too broad (based on regional studies) or too narrow (based on specific project sites) to help with land use planning decisions.

Land use decision makers also need better information about the cumulative impacts of development on water quantity and quality, including better information about the carrying capacity of land to absorb stormwater and wastewater through on-site disposal systems over the long-term.

Oregon's cities and counties employ a variety of techniques to meet statewide planning goals, including data collection and monitoring, for the protection of natural resources within their boundaries. The accompanying essay provides examples of protection efforts in Benton County and Marion County.

Greg Verret, Benton County
and Lisa Milliman, Marion County

Using County Codes and Outreach to Collect Data, Make Decisions, and Educate Residents

Benton County's Development Code requires demonstration of an adequate water supply (both quantity and quality) to serve any proposed development. The quantity requirements are scaled to the development and range from pump tests for building a home to a full hydrogeologic study in a large-land subdivision. In 2011, the County adopted erosion control and long-term stormwater management requirements for new developments, as well as an ordinance prohibiting discharge of pollutants to streams and stormwater conveyances. The County is also developing a stream, wetland, and riparian protection program for rural portions of the county.

Marion County's Rural Zone Code requires water level measurements for wells on newly approved land divisions or lots, along with a requirement to implement a well monitoring program for new subdivisions. Marion County has initiated an ongoing public outreach effort to educate landowners about proper use and maintenance of onsite sewage treatment systems and identifying old, poorly designed systems that should be upgraded, especially in areas where water quality problems have been identified, clusters of small properties along salmon bearing streams and rivers, and areas with shallow wells and small lots.

Perspectives from Oregon's Counties

In 2011, the Water Resources Department conducted a survey of Oregon's county commissioners to better understand where information is lacking and what improvements could be made to connect land use planning and water resources planning. Twenty-three of Oregon's 36 counties participated, responding to questions regarding their water-related data needs, the status of integrated water resources planning, their relationships with stakeholders, and the types of assistance needed from state agencies.

Water-Related Issues

Commissioners noted which water issues had come before their county commissions during the past 12 months. Counties have had very different exposure to water-related issues, with more than half of the respondents (12 counties) discussing at least seven water-related issues during the past year. One county commission reported having discussed all 16 of the listed issues, compared with two commissions that had dealt with only one issue each.

The issues themselves were wide-ranging, with the most frequent discussions focusing on the need for better water data (indicated by 15 counties), water resources planning (14), water-related funding (14), water quality (13), and wastewater infrastructure (12). See accompanying table.

The Number of County Commissions Discussing…

15	Water Data
14	Water Resources Planning
14	Water-Related Funding
13	Water Quality
12	Water Related Infrastructure
11	Water Conservation
11	Water & Energy Development
11	Water Storage
10	Water Reuse
10	Streamflow Restoration
9	Public Health & Water
9	Water Education & Training
9	Water Supplies
8	Ecosystems & Water
6	Climate Change & Adaptation

November 2011 Survey of Oregon Counties – OWRD

Commissioners then responded as to whether they feel their county commission is well versed in water resources issues. Responses diverged widely, but tended toward the negative, with nine respondents "disagreeing" or "strongly disagreeing" with the statement.

Results tended even more toward the negative when asked to comment on whether their county is well underway with county-wide, integrated water resources planning (meeting water quantity, water quality, and ecosystem needs). More than half of the counties represented (12), did not believe their counties were participating in such planning activities.

County & Stakeholder Relationships

In an effort to discern how well county commissions are positioned to undertake or participate in place-based, integrated water resources planning, the survey asked about the nature of their relationships with local stakeholders and partners. In general, the surveyed commissions indicated regular contact existed between counties and soil and water conservation districts, watershed councils, and irrigation districts. Regular contact with wastewater and stormwater managers, businesses, and municipal water providers occurs less often. County commissions have the least contact with environmental groups and tribes. Of all stakeholder groups, survey respondents ranked their working relationships with neighboring county commissions as the highest.

State Assistance

Finally, the survey asked commissioners what is needed to assist with local water resources planning. "Funding with grants" was the most frequent response (indicated by 16 counties), followed by providing water quality data (12), providing water availability data (11), assistance identifying other funding sources (9), and identifying best practices in water management (8).

Recommended Action 6.A
Improve Integration of Water Information into Land Use Planning (& vice-versa)

How to implement this action:

- Develop and share information regarding the location, quantity, and quality of water resources
- Protect water sources in the course of land use decisions

Importance Confirms Previous Survey

Feedback from the 2011 survey also confirms the results of a previous water supply planning survey of county planners conducted a few years ago. In that survey, counties also ranked water data as their number one need. The majority of counties surveyed in 2007 (85 percent), requested more information on the availability of water supplies in their communities, more specifically, groundwater.

Oregon should improve the integration of water information into land use planning, and vice-versa. This involves developing and sharing information regarding the location, quantity, and quality of groundwater resources. Such information would help inform comprehensive plans, shovel-ready certified sites, capital improvement plans, water management and conservation plans, and other activities that contribute to land use decisions. Studies of exempt-use wells, assessments of drinking water sources, and improved information regarding underground injection control systems would aid community-based protection and management strategies. This information is critical to protecting water sources during the course of land use decisions.

Coordination among State and Local Governments

Each local government in Oregon with responsibility for land use management coordinates with various state agencies to ensure that state agency actions (e.g., permitting) are consistent with local comprehensive plans, and vice versa. The Water Resources Department, for example, coordinates with

local governments on actions involving applications for water use permits, transfers, water exchanges, instream water rights, and reservations for economic development.

To ensure compliance and compatibility with local comprehensive plans, twenty-five agencies have developed State Agency Coordination Programs, most of which were certified by the Land Conservation and Development Commission around 1990. Since that time, only one state agency has updated its State Agency Coordination Program.

Recommended Action 6.B
Update State Agency Coordination Plans

How to implement this action:
- Update State Agency Coordination Programs in coordination with DLCD

Changes to state rules and programs, and to comprehensive plans, may lead to incompatibilities that are detrimental to public and private interests. The Strategy should ensure that state agency coordination programs are keeping pace with local permitting decisions and changes in comprehensive plans, while meeting multiple state agency requirements.

Low Impact Development & Green Infrastructure

Runoff from urbanized land areas and impervious areas such as paved streets, parking lots, and building rooftops during rainfall and snow events often contains pollutants that adversely affect water quality. This polluted runoff commonly includes heavy metals, pesticides and fertilizers, oil and grease, bacteria, and sediment. The U.S. EPA describes urban runoff as one of the leading sources of water quality impairment in surface waters. Urban sources can also contaminate groundwater. Humans and their actions are the most significant sources and causes of polluted runoff.

The negative effects of polluted runoff to human health and watershed health can be minimized through effective stormwater management. In 2007, the Oregon Environmental Council convened a stormwater solutions team to look for ways to reduce stormwater impacts in Oregon's urban landscapes. The team identified two major approaches to accomplish this: 1) improve the way stormwater is managed by promoting green infrastructure and other best management practices; and 2) reduce the source of pollutants commonly found in stormwater.

Recommended Action 6.C
Encourage Low Impact Development Practices

How to implement this action:
- Compile and provide online information on low impact development policies 🕮
- Update local development codes, improving local capacity to review and permit green infrastructure designs

The use of low impact development and green infrastructure may help cities and counties meet statewide goals for water quality, particularly in management of stormwater and urban runoff. A 2008 report by OSU's Sea Grant Extension Program and the Oregon Department of Land Conservation and Development (LCDC) defines low impact development (LID) as a "stormwater management strategy that emphasizes conservation and use of existing natural site features integrated with distributed, small-scale stormwater controls to more closely mimic natural hydrologic patterns in residential, commercial, and industrial settings."

The U.S. EPA describes green infrastructure as generally referring to systems and practices that use or mimic natural processes to infiltrate, evapotranspirate, or reuse stormwater or runoff on the site where it is generated. Green infrastructure is actually very similar to low impact development in its approach to managing water resources. The goal of both approaches is to treat stormwater runoff at its source before

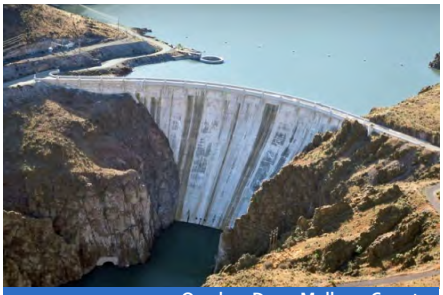
it reaches the sewer system. This can be done through the use of bioswales, rain gardens, or vegetated roofs, for example. Rainwater harvesting is another useful approach, one that utilizes water as an on-site resource for activities like lawn watering or gardening.

LID Barriers and Opportunities

The OSU/DLCD report referenced earlier also examined the barriers and opportunities for employing low impact development designs among three Oregon communities. One significant theme that emerged was a lack of basic understanding—a disconnect between today's land use and development decisions and tomorrow's consequences, in terms of both costs and resource quality.

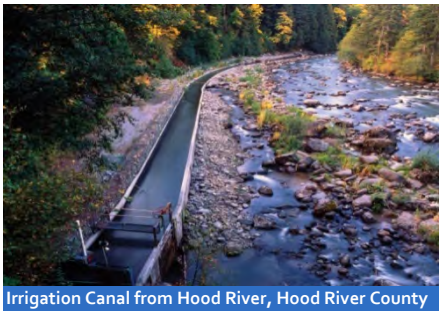
The report also found a need for strong administrative support and direction to incorporate LID practices into codes or to encourage developers to try such projects. Local planning departments need technical resources and assistance to help familiarize themselves with low impact techniques, and to allow such projects to move through the local government approval process. Oregon's public and private partners should compile and provide information on LID policies in cities and counties across the state, as it would help encourage more effective use of these practices. Oregon communities should consider updating local development codes, where appropriate, and improving local capacity, both technically and legally, to review and permit green infrastructure designs.

CRITICAL ISSUE: WATER-RELATED INFRASTRUCTURE



Owyhee Dam, Malheur County

Bonneville Fish Ladder, Columbia River



Irrigation Canal from Hood River, Hood River County

Photos: U.S. BOR; U.S. ACE; G. Scholl-Erdmann, Farmers Conservation Alliance

Infrastructure is another important, but often overlooked, piece of the water equation. It takes an extensive system of pumps, pipes, treatment, and storage facilities to deliver water to our homes, businesses, and farm fields every day. In the United States, drinking water alone is delivered through a network of more than one million miles of pipes, and wastewater sewer lines cover more than 600,000 miles.

Maintaining the infrastructure to move water and wastewater is an expensive, but necessary task. Much of the nation's infrastructure is aging and will soon reach the end of its useful life. Ensuring that Oregon's water-related infrastructure is well maintained and functioning is important for a variety of public health and safety reasons, but also for meeting our state's economic needs.

Infrastructure for Irrigation

Irrigation districts throughout Oregon are responsible for maintaining the infrastructure needed to divert and transport water to their patrons. The Oregon Water Resources Congress, a nonprofit trade association, describes irrigation-related infrastructure as an integrated system that encompasses all of the components necessary to get the water from its source to the farm or other water users. Examples of irrigation infrastructure include:

- storage facilities, such as dams;

- the reservoir behind the dam (and any recreation facilities associated with it);
- regulating reservoirs;
- wells;
- diversion and delivery systems such as canals (lined and unlined) and pipelines;
- pumps and pumping stations;
- headgates, headworks, and valves;
- spillways; siphons; drains; penstocks (for power) and transmission lines;
- telemetry systems;
- measurement devices such as weirs, flumes, meters, gaging stations, and data loggers; and
- infrastructure for species and habitat, such fish screens and fish passage facilities.

The cost of delivering water, which includes maintaining all of the infrastructure components listed above, is typically covered by irrigation district patrons or individual irrigators. Some irrigation and water districts have been successful in obtaining federal cost-share funding—through the Bureau of Reclamation's WaterSMART program, for example—to improve the efficiency of their water delivery systems. The presence of properly maintained irrigation infrastructure is incredibly important to Oregon's farmers and ranchers. Without it, many agricultural operations would not have any physical access to water because the source of irrigation water can be located several, or even hundreds, of miles away.

Other funding sources for irrigation-related infrastructure exist at the state level as well. The Oregon Department of Fish and Wildlife offers a cost-share program or tax credit to assist with installation of fish screening devices and passage facilities. Tax credits are also available through the Oregon Department of Energy for irrigation system improvements in pumping volume and head requirements that save annual energy usage from irrigation pumps. The Energy Trust of Oregon offers cash incentives for improvements in on-farm irrigation systems (linear, pivot, wheel, hand line), as well as irrigation pumps for customers within Pacific Power and Portland General Electric utility service territories.

Oregon needs to ensure that these and other funding mechanisms continue to be made available for water-related infrastructure for irrigation, but also for our drinking water and wastewater treatment facilities. This includes ensuring that basic maintenance needs continue to be eligible for grant and loan funding, such as fixing leaks, replacing wooden pipes, and installing measurement devices and other technologies. Grant and loan programs should continue to make funding available for the maintenance of existing systems, especially when it is more cost-effective than constructing new facilities.

Dams and Wells

In Oregon, the construction and maintenance of infrastructure, such as dams and wells, are regulated by the Water Resources Department. Such constructed facilities are inspected routinely by the Department to prevent system failures and contamination of water resources.

Dams

Drinking water, power generation, flood control, irrigation and recreation are a few of the benefits that dams can provide. Dams can also be used to release water to benefit instream needs, by augmenting streamflows at critical times for fish spawning and migration. The construction and repair of dam infrastructure can be extremely expensive. Dams require regular inspection to determine if actions are required to keep them safe. This is especially true of high hazard dams—those where, in the event of a dam failure, fatalities are likely.

There are more than 85,000 dams in the United States today that meet height and storage standards of the National Inventory of Dams, maintained by the U.S. Army Corps of Engineers. Of these "statutory"

dams, 1,567 are located in Oregon. Most of these dams are classified as low hazard, meaning there is little chance of fatalities or serious property damage if the dam should fail. At the present time, there are 129 high hazard dams in Oregon. Of these high hazard dams, 61 have been rated as being in satisfactory condition, 43 were rated in fair condition, 16 were rated in poor condition, and four of these dams were rated in unsatisfactory condition (five dams had insufficient data for rating).

Nationwide, the average age of a dam is about 51 years old. The National Infrastructure Report Card gave dams in the United States a "D" grade, citing that deficient dams are often a result of aging, deterioration, or lack of maintenance. The Oregon Section of the American Society of Civil Engineers rated Oregon's dam and levees a "C" grade, citing the lack of safety assessments for many of the irrigation structures in the state. The National Report Card further explains that more dams nationwide are being identified as unsafe or deficient because of an increased scientific understanding about large flood events and earthquakes, and the ability to predict a dam's structural response to such extreme events.

Oregon's Dam Safety Program

The Water Resources Department operates Oregon's dam safety program, reviewing and approving the design/specifications of new dams and existing dams that are undergoing major repair, along with conducting inspections on existing hydraulic structures that could pose a threat to life and property. The Department coordinates with other state and federal agencies on dam inspections and training for its personnel and dam owners.

In cooperation with the National Performance of Dams Program (NPDP), Oregon's Dam Safety Program keeps a current inventory of dams that meet both NPDP and Oregon criteria. Dams that are ten feet or greater in height and also impound 9.2 acre-feet (3,000,000 gallons) or more are subject to the requirements of the Dam Safety Program. As of September 2011, approximately 1,300 dams are within Oregon's dam safety jurisdiction for design review, and of these, OWRD has lead inspection responsibility for 940 dams. High hazard dams have annual periodic inspections, significant hazard dams are inspected every two to three years, and low hazard dams are inspected every five to six years. Oregon's dam safety engineer is assisted in the field by the Department's watermaster corps.

As structures age and additional seismic information becomes available, Oregon's state agencies are encouraging dam owners to evaluate and retrofit dams in anticipation of seismic events, aging, and other extreme events. The Water Resources Department encourages dam owners to evaluate and modify dams, as needed, because of structural deterioration, potential earthquakes, and extreme floods. Doing this work requires significant financial resources. As more is known about the effects of climate change on local flooding, resources will be needed to conduct an evaluation of older dams and dams where the hazard rating has changed due to downstream development.

Oregon's Well Construction Program

Oregon's well construction standards are designed to protect groundwater resources and the public by preventing contamination, waste, and loss of artesian pressure. With several thousand drilled each year, state oversight is critical to ensure wells are constructed using proper methods, materials, and equipment. Licensed and bonded water well constructors have the equipment, knowledge, and experience required for proper well construction.

Along with construction, any alteration, deepening, or abandonment of a well must be done in accordance with groundwater laws and general standards. Unused wells that are not properly abandoned provide avenues for contamination and are a public safety concern. In particular, abandoned, large-diameter, open wells could potentially lead to the trapping or drowning of small children or animals.

Decommissioning Dams and Wells

As with groundwater wells, some dams or other water impoundment structures no longer serve the purpose for which they were constructed. When a dam has significantly deteriorated, the costs of repair may exceed the expected benefits, and dam removal may be a less expensive alternative. For example, if fish cannot adequately pass upstream of the dam and reservoir, the cost of adequate fish passage facilities might exceed the project benefits. In such a case, dam removal may be a less expensive alternative. Other reasons for dam removal can include renewed access to submerged cultural or historic resources or improved access to white-water recreation.

Infrastructure, dams and other facilities and structures that have been abandoned or are otherwise non-operational and in derelict condition should be identified and removed/decommissioned, and the sites occupied or affected by them should be restored to pre-project conditions.

Planning for Infrastructure Emergencies

In Oregon, money from FEMA grants is used to help dam owners create Emergency Action Plans (EAP). An EAP helps identify situations where a dam failure might occur, actions to take that could save the dam, if possible, and evacuations in situations that could result in dam failure. There is an Oregon-specific EAP template available, designed for owners of remote dams that have limited personnel. Approximately 75 percent of state-regulated high hazard dams have, or are currently developing EAP's. The State is encouraging the development of emergency action plans (EAP) for all remaining high hazard dams in Oregon.

Using an Asset Management Approach

The approach in the utility industry is to encourage an "asset management" approach, upgrading and replacing water and wastewater infrastructure when it no longer serves its purpose. Asset management means taking a systematic approach to managing capital assets in order to minimize costs over the useful life of the assets, while maintaining adequate service to customers.

In 2009, the League of Oregon Cities surveyed its members to obtain information about utility rates and other system characteristics. The survey asked, among other things, whether communities have asset management plans and whether those plans are sufficiently funded.

For communities with less than 10,000 residents, a significant percentage of systems do not have asset management plans in place for water and wastewater systems. Communities between 10,000 and 25,000 have the highest percentage of systems with asset management plans, yet most of those systems are deemed inadequately funded.

Of the largest systems—those serving greater than 25,000 people—more than 40 percent do not have a water utility asset management plan.

For stormwater utilities, asset management planning is lacking, compared to water and wastewater planning. The survey found that

Recommended Action 7.A
Develop and Upgrade Water & Wastewater Infrastructure

How to implement this action:

- Improve dam safety; retrofit for seismic issues
- Develop emergency action plans for high hazard dams
- Properly abandon infrastructure at the end of its useful life
- Use an "asset management" approach to identify and plan for rehabilitation, upgrade or replacement of infrastructure
- Ensure that basic maintenance needs continue to be eligible for grant and loan funding
- Advocate for continued infrastructure funding
- Encourage communities to consider natural infrastructure in lieu of, or as a complement to, built infrastructure

60 percent of the largest systems who responded reported not having a stormwater asset management plan, and for those that do, only 20 percent are adequately funded.

The U.S. Environmental Protection Agency's (EPA) Sustainable Water Infrastructure Initiative includes asset management among its examples of best management practices. The EPA already encourages asset management because it can help utilities reduce overall costs for both operations and capital expenditures, improve responses to emergencies, and improve the security and safety of assets.

Regional Infrastructure

Many Oregon communities, particularly smaller ones, are struggling to adequately fund water and wastewater-related infrastructure. The high capital costs related to infrastructure, the construction, operation, and maintenance cost of facilities, and the salary and training costs of retaining qualified personnel all seem prohibitively expensive to communities with a small ratepayer base. In Oregon, these tend to be rural, coastal, and/or small urban communities.

The financial need for water infrastructure continues to grow nationally. In EPA's 2009 Drinking Water Infrastructure Needs Report (based on 2007 data), the state of Oregon reported a total need related to water infrastructure financing of $3 billion. This compares to an overall national need of $325 billion, for water transmission, source water protection, treatment, and storage needs. This dollar figure places Oregon at the lower end of the "need" scale, particularly compared to states on the east coast. This may be in part because Oregon's infrastructure is newer by comparison, and because Oregon has fewer, less dense population centers.

Recommended Action 7.B
Encourage Regional (Sub-Basin) Approaches to Water and Wastewater Systems

How to implement this action:

- Provides incentives, such as funding and technical assistance

In 2002, the U.S. Government Accountability Office surveyed several thousand drinking water and wastewater utilities and found that a significant percentage of the utilities—29 percent of the drinking water utilities and 41 percent of the wastewater utilities—were not generating enough revenue from user rates and other local sources to cover their full cost of service. Roughly one-third of the utilities 1) deferred maintenance because of insufficient funding, 2) had 20 percent or more of their pipelines nearing the end of their useful life, and 3) lacked basic plans for managing their capital assets.

Developing a regional water and wastewater system makes sense, if it is cost-effective. A regional system could include physical consolidation, system redundancy, or shared contracts, services, and purchases. State and federal agencies often provide incentives such as funding and technical assistance to encourage a regional approach to meeting water needs. Oregon should continue providing these types of incentives to encourage more regional approaches to providing water and wastewater services to Oregonians, especially if it provides significant financial and environmental benefits within these smaller communities.

Infrastructure Funding for Drinking Water and Wastewater Systems

There are several agencies and organizations in Oregon aimed at helping communities with the financial costs of water-related infrastructure. The Infrastructure Finance Authority (IFA), for example, is a state agency that helps communities build infrastructure capacity to address public health and safety issues, as well as support their ability to attract, retain and expand businesses.

The IFA has resources available to finance water and wastewater infrastructure needs through Community Development Block Grants, the Water Fund (a special public works fund and water/wastewater financing program), and the Safe Drinking Water Revolving Loan Fund. Several million dollars have been awarded through these programs from 2001-2010 (see table below). Funding has also been provided for technical assistance projects, such as developing or updating facility plans, system master plans, engineering studies, and preliminary or final designs for projects.

IFA Water and Wastewater Project Awards by Financing Program (2001-2010 totals)

Water Infrastructure	Wastewater Infrastructure	Water Tech. Assistance	Wastewater Tech. Assistance
Community Development Block Grants			
$ 12.8 million	$34 million	$1.37 million	$5.6 million
Water Fund *(Includes Special Public Works Fund and Water/Wastewater Financing Program)*			
$44.3 million	$58.25 million	$0.46 million	$1.5 million
Safe Drinking Water Revolving Loan Fund			
$227 million	n/a	n/a	n/a

Federal funds for the Community Development Block Grant program and the Safe Drinking Water program have been declining the last few years, and are expected to continue to decline further. Oregon will need to continue advocating for continued funding of revolving loan funds from the federal Clean Water Act and Safe Drinking Water Act. Recapitalizing the state's Special Public Works Fund will be needed to continue providing low interest loans and grants to partially offset capital costs of building new infrastructure or updating existing infrastructure.

Some communities choose to finance part of their water and wastewater infrastructure portfolio through the bond market, as described in the following essay.

Jim Wrigley and Katie Schwab,
WedBush Securities, Inc.

Financing Water Projects with Bonds

Water-related projects are often financed with bonds that can be secured by the full faith and credit of the issuer (taxes and other lawfully available funds), by revenues generated by the water system, or by assessment to properties that benefit from the project. The Local Oregon Capital Assets Program (LOCAP) is a pooled financing program co-sponsored by the League of Oregon Cities and Association of Oregon Counties. LOCAP provides financing for water, wastewater and stormwater projects. Documents are standardized and the costs of issuance are prorated amongst participants. Participants are only responsible for their own obligations.


Streamflow Measurement Demonstration


Public Works in Action


Stream Ecology

Photos: T. Louden, OWRD; F. Reed, Tualatin Valley W.D.; T. Price, Oregon's Environmental Literacy Plan

Although Oregon is generally regarded as a "wet" state, many watersheds and their surrounding communities are facing water scarcities today. Looming pressures on our water resources, including population growth and climate change, are not yet "real" in the personal lives of many Oregonians, making it difficult to convey the seriousness of the issues we face today and may face in the future. Education and outreach efforts by state agencies and their partners should be targeted to all age levels and should address water quality, water quantity, and ecological needs and issues.

The health and sustainability of Oregon's water resources could benefit greatly from a variety of education and outreach efforts. The value of water and the role that it plays in Oregon's economy and the environment is not always well understood, or even recognized. Oftentimes, access to safe and abundant water is taken for granted. Everyone, both young and old, can benefit from a reminder that our human activities and decisions can have a significant impact on both the quantity and quality of our water, as well as the many economic and ecological uses it supports.

Oregon's Environmental Literacy Plan

In 2009, the Governor and the Oregon Legislature launched the development of an Environmental Literacy Plan as part of the *No Child Left Inside Act*. Oregon is the first state to pass legislation directly related to the development of an environmental literacy plan. The Plan, finalized in October 2010, is aimed at helping students become lifelong stewards of their environment and community, exercising the rights and responsibilities of environmentally literate citizenship, and making choices to interact frequently with the outdoor environment.

One of the goals of the Plan is to prepare students to understand and address the major environmental challenges facing Oregon and the rest of the country, including the relationship of the environment to national security, energy sources, climate change, health risks and natural disasters.

Recommended Action 8.A
Support Implementation of Oregon's K-12 Environmental Literacy Plan

How to implement this action:

- Support funding for implementation
- Natural resource agencies, community organizations, and others should engage in education for environmental literacy activities.

The Plan provides an opportunity for Oregon's youth to gain a greater understanding about the state's vital natural resources, and to develop a sense of stewardship toward Oregon's environment, thus helping them make informed decisions about Oregon's natural resources in the future. Under this Plan, students graduating from high school should be environmentally literate.

Fortunately, high quality, water-related curricula exists for all ages. Project WET, established in 1984, has a coordinating center at Western Oregon University, and other coordinating centers located nationally and internationally. Project WET's materials, available for a fee, provide a good overview of water quality and quantity issues, focusing on topics such as watersheds, wetlands, oceans, sanitation and hygiene, water history, and more.

The U.S. Environmental Protection Agency and the U.S. Geological Survey also have water related resources available for K-12 education. Many local water providers, watershed councils, and non-profit organizations in Oregon have also developed their own educational and outreach materials. Oregon's natural resource agencies, community organizations, and others should continue engaging in education for environmental literacy activities in support of Oregon's Environmental Literacy Plan. Oregon should also support funding for implementation of the Plan.

Oregon's Next Generation of Water Experts

The need to provide education and training on water, specifically water management, took center stage several decades ago. During the 1970s and 80s, the water and wastewater treatment industry grew rapidly to fulfill the requirements of the federal Clean Water Act and the Safe Drinking Water Act.

During that time, grants from the U.S. Environmental Protection Agency also became available for states to train water and wastewater plant operators. Now, with impending retirements expected from the baby boomer generation, the water and wastewater industry faces some devastating losses in its workforce.

The Water Environment Federation appointed a task force on water sustainability to look at this issue. In its 2008 final report, the task force noted that 37 percent of water utility workers and 31 percent of wastewater utility workers in the United States would retire by 2018. Add to this a 2003 Congressional Budget Office study noting that a shortage of qualified workers in *all* industries is expected to continue for an entire generation, comprising almost two decades. Although retirements have slowed a bit due to the economic recession, the loss of knowledgeable staff is still a concern.

One troublesome worry that comes with this wave of retirements is well described in a 2005 paper, *Succession Planning for a Vital Workforce in the Information Age*, which notes that much of our systems information in the U.S. is not well documented, making 80 percent of useful operating knowledge susceptible to loss through retirements.

Changes in the Water Industry

The gap left by these departures is further compounded by the rate at which scientific advancements have changed the water industry. In the Journal *Science* (May 2010), author Carol Milano examines the growing list of needs in a very diverse field of water. Milano notes the increasing recognition for the value of restoring ecosystems to their natural condition will demand more scientists trained in ecological areas such as soils, biology, zoology, chemistry, and geology, as well as environmental, civil, and mechanical engineering.

Manufacturers who are trying to decrease water use and toxic discharge need chemical engineers, synthetic and system biologists, and nanotechnologists. Regulatory agencies and environmental health professions need toxicologists, epidemiologists, chemists, engineers, hydrologists, and legal and policy professionals.

According to the Bureau of Labor Statistics, employment growth of 18 percent is expected for hydrologists between 2008 and 2018, which is faster than the average for all occupations. Employment

of the broader category of environmental scientists and specialists is expected to increase even more, by 28 percent between 2008 and 2018. The need for energy, environmental protection, and responsible land and water management will spur this demand.

Recommended Action 8.B
Provide Education and Training for Oregon's Next Generation of Water Experts

How to implement this action:

- Conduct a survey of water organizations in Oregon 🕮
- Determine whether educational programs in Oregon are equipped to meet the coming demand for water professionals
- Offer internships, fellowships, and job shadow programs to expose students to careers in water
- Continue funding support for water-related trade programs at Oregon community colleges

The Bureau of Labor Statistics explains that the demand for hydrologists will be strong as the population increases and moves to more environmentally sensitive locations. As more people migrate toward coastal regions, for example, hydrologists will be needed to assess building sites for potential geologic hazards and to mitigate the effects of natural hazards such as floods, landslides, and hurricanes.

Hydrologists also will be needed to study hazardous waste sites and determine the effect of pollutants on soil and groundwater so that engineers can design remediation systems. Increased government regulations, such as those regarding the management of stormwater, and issues related to deteriorating coastal environments and rising sea-levels will stimulate employment growth for these workers.

Professional Water-Related Training in Oregon

The Oregon Community College Association reports that out of the seventeen publicly chartered community colleges in Oregon, only two community colleges offer water/wastewater operator training programs: Linn-Benton Community College (Albany) and Clackamas Community College (Oregon City).

These programs are critical resources for plant operators, as they prepare for the certification and licensing exams underpinning the water and wastewater utility industry. These courses are designed to give water technicians and operators the tools to protect public health and environmental health.

There is only one community college, Lane Community College in Eugene, with a water conservation technician program—specializing in the nexus between energy and water efficiency. There are no community college programs in Oregon with a robust curriculum in hydrographics—measuring water level and streamflows, and then processing the records for use after data collection.

The American Water Works Association, the Water Environment Federation, and the U.S. Environmental Protection Agency have partnered to create a website to promote career choices in the water sector. Geared toward jobseekers at all levels—high school, vo-tech, college, military second career, and advanced science—the workforwater.org website hosts a clearinghouse of jobs in the field of water. It also contains recruiting resources for businesses and agencies to use. The Oregon Department of Community Colleges and Workforce Development also provides a listing of colleges that offer water-related courses, degrees, and programs throughout Oregon.

Community-Based Education and Outreach

Two public surveys were recently conducted by Oregon State University to assess citizen attitudes and opinions toward water issues in Oregon. About 800 Oregonians responded to the surveys, answering questions about their level of knowledge, resources they use for information, and a number of factors that potentially pose a risk to Oregon's water resources—quality and quantity.

According to the surveys, most Oregonians prefer (and are using) television news programs or specials to learn about the state's water situation. Oregonians use local newspapers, radio programs, and online resources to gather information as well. Unfortunately, only 5 percent of Oregonians consider themselves very well informed about water issues in Oregon.

Stronger partnerships with news outlets would help educate the public about water issues.

Through the OSU surveys, Oregonians ranked drinking water as the most important use of water in Oregon. With drinking water ranked as the highest priority, it is not surprising that a separate survey by DHM Research in November 2011 found that water quality protection to be the number one environmental concern of residents in the Pacific Northwest.

Recommended Action 8.C
Promote Community Education and Training Opportunities

How to implement this action:

- Continue to promote education and outreach through actions required in local Water Management and Conservation Plans
- Promote technical training for public and private partners 🕮
- Promote access to water-related recreational opportunities through the use of the Water Trails Program

Interestingly, the OSU survey found that only 1 in 5 Oregonians were familiar with the term "non-point source pollution," which U.S. states report as the leading remaining cause of water quality problems, according to the U.S. Environmental Protection Agency.

Opportunities to Expand Efforts

Oregon is home to an extensive network of community-based organizations that offer technical assistance and knowledge on water quantity, water quality, and watershed-related issues. With more than 45 soil and water conservation districts, and about 85 watershed councils located throughout the state, Oregon is well positioned to advance education and outreach efforts. Oregon should continue providing technical training to soil and water conservation district staff, watershed councils, and other on-the-ground organizations.

Examples of education and outreach opportunities that should be promoted include:

- farmer-to-farmer tours to demonstrate water conservation and efficiency techniques;
- water quality testing of private wells for homeowners (well owners need information about how to test wells, how to interpret the results, and what course of action is needed to address the contaminants);
- proper care/maintenance for septic systems;
- graywater use;
- rainwater harvesting;
- pharmaceutical take back programs, hazardous waste collection events; and
- streamflow restoration programs and opportunities.

Children's Clean Water Festival

The Clean Water Festival is a community-supported event, organized by public, private, and non-profit organizations committed to water and environmental education in Oregon. The festival's goal is to teach children that they are capable of having real, long-lasting, positive impacts on water resources, and to equip them with the information they need to do that in a fun and engaging way.

Responsible use and protection of Oregon's water resources can be done by promoting water-related recreational opportunities as well. The Water Trails Program at the Oregon Parks and Recreation Department, for example, helps to increase access to water-based outdoor recreation and stewardship of the state's waterways. Water trails are highlighted through the use of comprehensive trail guides, signage, public outreach, and informative classes to encourage awareness of the natural, cultural, and historical attributes of a waterway. This gives water users an opportunity to learn about the value of water resources, while gaining boating skills and connecting with waterways through an outdoor experience. The Water Trails Program, and other outdoor water-related recreational opportunities, should be promoted and encouraged in Oregon.

Recommended Action 8.D
Identify Ongoing Water-Related Research Needs

How to implement this action:

- Continue to identify ongoing research needs at the local and state level 🕮
- Partner with public and private researchers

Water Related Research Needs

The water resources sector will need to continue identifying on-going informational needs that could use assistance from undergraduate and graduate students, as well as public and private research institutions and partners. Examples of identified research needs are marked throughout the Strategy with the book (🕮) symbol.

Recommended Actions at a Glance

Objective 3: Understand the Coming Pressures That Affect Our Needs and Supplies

Water & Energy	4.A. Analyze the effects on water from energy development projects and policies 4.B. Take advantage of existing infrastructure to develop hydroelectric power 4.C. Promote strategies that increase/integrate energy & water savings
Climate Change	5.A. Support continued basin-scale climate change research efforts 5.B. Assist with climate change adaptation and resiliency strategies
Water & Land Use	6.A. Improve integration of water information into land use planning (& vice versa) 6.B. Update state agency coordination plans 6.C. Encourage low-impact development practices
Infrastructure	7.A. Develop and upgrade water and wastewater infrastructure. 7.B. Encourage regional (sub-basin) approaches to water and wastewater systems
Education & Outreach	8.A. Support implementation of Oregon's K-12 Environmental Literacy Plan 8.B. Provide education and training for Oregon's next generation of water experts 8.C. Promote community education and training opportunities. 8.D. Identify ongoing water-related research needs

CHAPTER 4

MEET OREGON'S INSTREAM AND OUT-OF-STREAM NEEDS

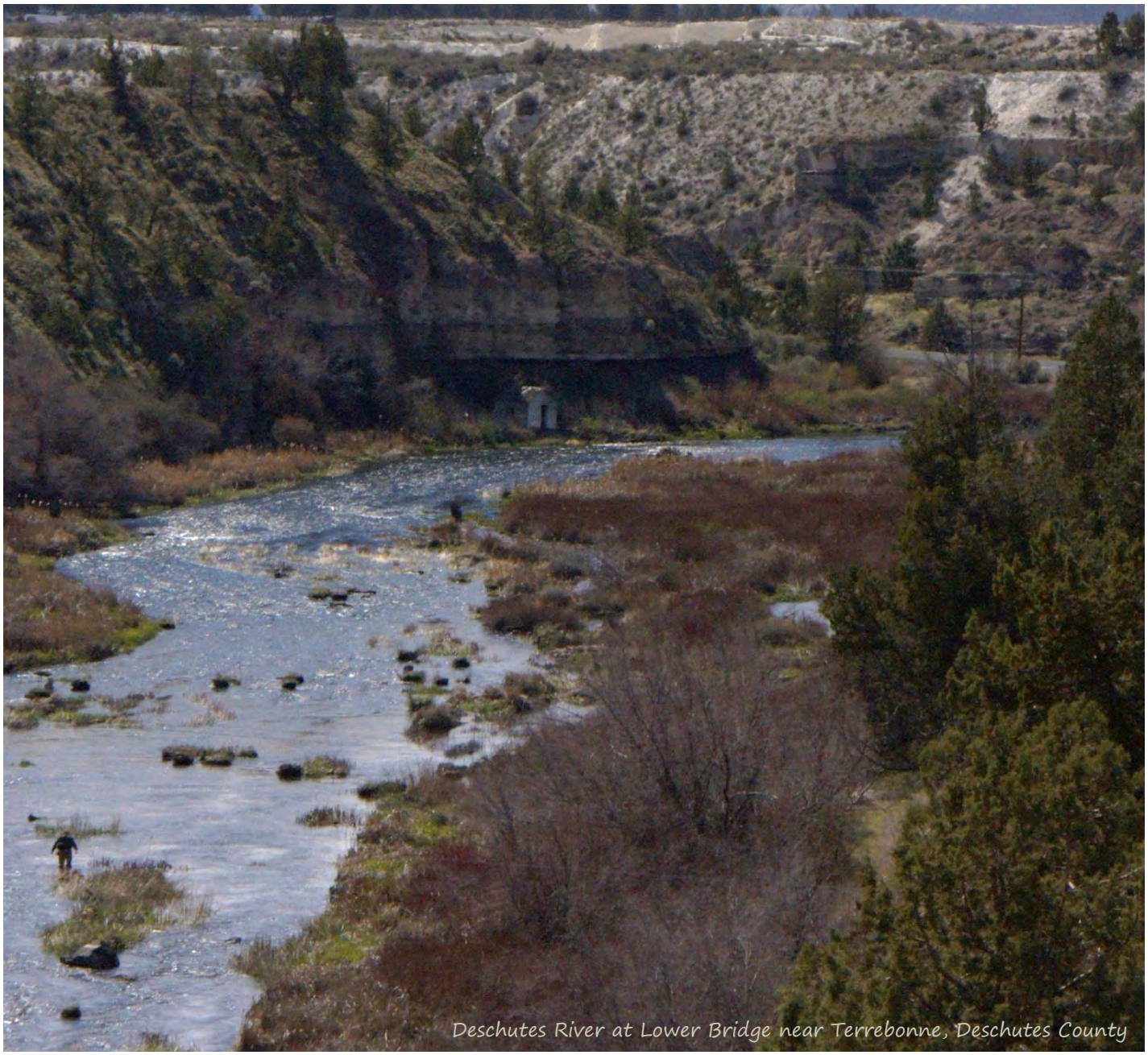


Photo: Kyle Gorman, OWRD

Deschutes River at Lower Bridge near Terrebonne, Deschutes County

Place-Based Efforts

Water Management & Development

Healthy Ecosystems

Public Health

Funding

Oregon needs to further integrate and coordinate both the long-term planning and day-to-day management of Oregon's water resources among its natural resource and economic development agencies, at all levels of government. Key factors to consider include state-level and place-based water planning, water management and development, and the protection of ecosystems and public health. The Strategy's objectives of better understanding and meeting our water needs will be meaningless without adequate funding.

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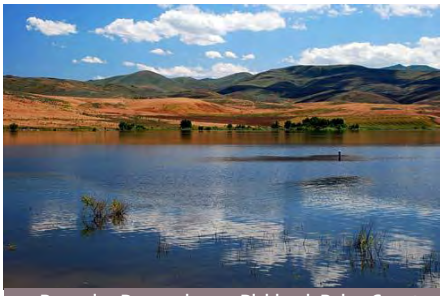
Brownlee Reservoir near Richland, Baker County


North Umpqua River, Douglas County


Nehalem Bay State Park, Tillamook County

Photos: Gary Halvorson, Oregon State Archives

Although everything we do in the natural resources community has a sense of "place," the concepts in this section specifically focus on three topics: place-based water resources planning, coordinating existing natural resource plans, and strengthening our communication and partnerships with tribes, federal agencies, and neighboring states with which we share water resources.

Because every river basin in Oregon is unique with widely varying ecological issues, community values, and economic dynamics, place-based integrated water resources planning is vital to meeting Oregon's water management challenges. Such planning enables communities to engage in a collaborative process to determine how best to meet their unique instream and out-of-stream water needs. Place-based efforts provide a venue for water managers to interact with the people who live, work, and play in a watershed and care deeply about it.

Place-based planning allows these conversations to take place at a scale that a statewide strategy may not be able to achieve. Voluntary place-based plans can "roll up" and inform the statewide Strategy. Place-based plans can leverage technical and funding resources available through the Strategy to make more meaningful local impacts. This approach is meant to empower communities to conduct voluntary, place-based integrated water resources planning in consultation with the State.

Bev Bridgewater, West Extension Irrigation District
& Brad Bogus, Tetra Tech Inc.

Municipal – Agricultural Partnership – Example

The City of Hermiston and West Extension Irrigation District have partnered with state and federal agencies to reclaim highly treated municipal wastewater, mix it with river water, and deliver it to agricultural customers, including ranchettes, gardens, orchards, and fields of potatoes, corn, and alfalfa.

At full capacity, the City expects to supply about 3.5 cubic feet per second (CFS) of water, from late spring until the end of the irrigation season each year. This will save the District about $22,000 annually in pumping costs from the Umatilla River. In turn, the City saves money by not having to chill its discharge.

This project will utilize wastewater discharge from the City, treated to levels that meet food quality standards (Class A water). The District will not jeopardize an existing agricultural exemption for its own discharge, under the federal Clean Water Act; and the City must have a fail-safe process in place so that no untreated water will go to the District.

Designing a Template for Place-Based Efforts

In order to successfully take a place-based approach to water resources management, the State must develop a template of guidelines to ensure that plans are integrated, addressing instream and out-of-stream needs, including water quantity, water quality, and ecosystem needs. Plans should account for the interaction between groundwater and surface water. Plans should also delineate and describe local population centers, key industries, and listed fish species, among many other factors that influence the use and management of water.

Recommended Action 9.A
Undertake Place-Based Integrated, Water Resources Planning

How to implement this action:

- Develop a template for place-based integrated water resources strategies
- Provide technical assistance and other incentives to communities undertaking place-based IWRS
- Compile relevant and readily-available water-related information to support place-based IWRS

At a minimum, the State and the template it designs must ensure that any place-based plan seeking state funding and/or state approval under the Strategy must recognize the public interest in water, and have a meaningful process for public involvement, with public meetings, and a balanced representation of all interests.

Inherent in any place-based plan is the recognition and commitment to the State's authority and responsibility for management of water resources. A place-based planning effort will need to comply with existing state laws and requirements. Having full participation by state and federal agencies, tribes, and non-governmental organizations will be important for achieving this; their expertise will help guide stakeholders through the planning process.

The State, working primarily through the four agencies involved with development of the Strategy, will develop the template and seek further grant funding and other incentives to assist with local planning efforts. Basic components of the template should include the following concepts:

- A description—quantity and quality—of current water resources (surface water, groundwater, storage, wastewater, stormwater), as well as a description of current and future water needs, both instream (ecological and biological needs, recreation, navigation) and out-of-stream (agricultural, municipal, industrial, including energy). Plans should note any specific data gaps, and any difficulties meeting instream and out-of-stream needs.

- A description of areas served by irrigation districts, and drinking water, wastewater, and stormwater utilities (include service area, status of infrastructure, status of contracts). This description should also note any difficulties meeting needs.

- Provisions for drought management and climate change adaptation and analysis of potential effects on quantity and quality of surface water and groundwater, as well as potential effects on demand/need.

- A discussion of other water plans (TMDLs, recovery plans, forestry plan, etc.) to the extent that data are available and provide direction for decision-making.

- Potential options to match future demands with supplies; the status of and opportunities related to water management and development tools in the basin, particularly water right transfers, water storage (both built storage and natural storage), water-use efficiency and conservation, water reuse, and restoration. This approach is meant to develop and evaluate water-resource scenarios.

The State should consider formally establishing the template, specifying the details of basin or sub-basin integrated water resources strategies, and ensuring ample public notice and comment prior to the approval process. The State already provides templates for other planning efforts, such as water management and conservation planning (described later in this chapter), which could be used as a model or example for place-based efforts. To build planning capacity and test the place-based planning concept, the establishment of pilot projects should be considered. This work will depend greatly on the availability of agency field staff.

Potential incentives to encourage place-based planning could include access to state and federal technical assistance, including hydrologic modeling; bundling state and federal water-resources funds to facilitate implementation of plans; a long-term commitment by the State to coordinate/implement other plans; recognition of place-based water resources plans by multiple state agencies; and facilitated permitting.

One area of need that communities have identified is a tool that models or evaluates the impact of policy and program options. Many communities do not have the tools to ask and answer "what if" questions when they are conducting water resources planning. An example of one such tool could arise through the Willamette Water 2100 project, an effort spearheaded by Oregon State University, University of Oregon, and Portland State University. The National Science Foundation is funding this three-year project that will attempt to incorporate local hydrologic, meteorological, ecological, economic, legal, and other factors into a Willamette basin model.

Mark Anderson and Michelle Girts, CH2M Hill

Place-Based Partnerships – Examples

Urban Water Planning: Local Watershed

The City of Damascus, a 12,000-acre area in the Clackamas and Willamette Basins, is expected to grow to 50,000 residents by 2060. This semi-rural community at the eastern edge of the Portland metropolitan area was recently incorporated. To serve expected growth, the City developed an integrated water resources management plan for water, wastewater, and stormwater infrastructure. In cooperation with several regional service providers, this first-of-its-kind plan capitalizes on a unique opportunity to consider all the aspects of urban water management from a local watershed perspective.

Agencies Share Resources, Consensus for Long Range Plans

As primary drinking water supplier in Washington County, the Joint Water Commission prepared what may be the state's most comprehensive Water Management and Conservation Plan. It addresses the unique supply and conservation collective needs of all the associated water utilities using shared resources and consensus for long range planning. The Commission's four key players are the cities of Hillsboro, Forest Grove, and Beaverton, and Tualatin Valley Water District, each with existing water responsibilities and facilities.

A Public-Private Cooperative

The Talking Water Gardens project is a unique public-private partnership that enabled two cities (Albany and Millersburg) and a high-tech company (ATI Wah-Chang) to address their water needs as a cooperative. They pooled financial resources to plan and build a new kind of water reclamation system: an engineered wetland that mimics the cleansing and cooling characteristics that occur in nature. This award-winning project garnered federal financial support and was constructed for a fraction of the cost of conventional facilities, while improving Willamette River water quality for fish habitat and downstream uses, and providing recreational space to the community.

Coordinating Existing Natural Resource Plans

One of the major challenges of taking on a regional, more integrated approach to water planning is that in any given basin, there are multiple parties and interests to convene. These include irrigation districts, municipal water providers, conservation districts, watershed councils, drainage districts, wastewater and stormwater utilities, local governments (counties/cities), and environmental groups. In addition to this list are the state, federal, and tribal natural resource agencies with water, land, or fish management responsibilities, and other public, private, and non-profit organizations with an interest in water management and resource issues.

Recommended Action 9.B
Coordinate Implementation of Existing Natural Resource Plans

How to implement this action:

- Coordinate and reconcile existing ecological planning and restoration efforts
- Dedicate resources for state and local implementation

Within a basin or sub-basin, multiple planning documents that involve water management, directly or indirectly, may exist. Water management and conservation plans (by a municipal water provider, or irrigation district); fish conservation and recovery plans, BiOp implementation plans; basin plans for water allocation; Total Maximum Daily Load (TMDL) plans for improving water quality; and many local implementation plans are just a few examples. There are also local land-use plans; watershed restoration action plans; and locally developed agricultural water quality management plans. Taken together, these plans and their respective strategies engage a welter of agencies and entities at every level.

Each plan has its own goals and objectives, with varying expectations and outcomes, making it challenging for a group of basin stakeholders to conduct their own planning and to implement projects strategically that meet multiple water quantity, water quality, and ecosystem needs.

In envisioning a place-based approach to meet local needs, these existing plans and programs do not go away, but instead provide a baseline of information, history, and rules that must be considered, coordinated, and built upon. A place-based approach could help reconcile and implement the state's programs and plans more effectively.

Partnerships with Federal Agencies, Tribal Governments, and Neighboring States

Partnerships with federal agencies, tribes, and neighboring states have played an important and necessary role in Oregon history. A large percentage of Oregon's landscape is managed by federal agencies, and Oregon shares three major waterways with California, Washington, and Idaho. Oregon is also home to nine federally recognized tribes, all of which have responsibilities for protecting and managing water resources. The Strategy presents an opportunity to strengthen these government-to-government relationships. Place-based planning, data collection and sharing are just a few areas where new partnerships can emerge.

Federal Agencies

The federal government manages 53 percent of the land in Oregon, and 60 percent of forestlands. The Bureau of Land Management, for example, administers 15.7 million acres of federal lands in Oregon, more than one-quarter of the state's land base. The role of the federal government in natural resource management, and water resources management in particular, is significant. Groundwater basin investigations are one example, cited earlier.

Another example is the use of federal Biological Opinions (BiOps). Watersheds throughout Oregon are host to a number of threatened, endangered, and sensitive species. Federal BiOps set objectives for species protection by laying out actions to protect, enhance, or restore conditions for these species and their habitat.

A third example is storage infrastructure. Two federal agencies, the U.S. Army Corps of Engineers and U.S. Bureau of Reclamation, are key partners in the operation and contract management of critical pieces of water infrastructure, among them, federal reservoirs that store water for patrons of several irrigation districts located throughout Oregon. The Bonneville Power Administration also has a role in water management, as it markets wholesale electric power from several hydropower projects in the Northwest.

Tribal Government Relations

All of Oregon's natural resource and economic development agencies have built relationships with the state's federally recognized tribes on a government-to-government basis. Oregon was the first state to adopt a formal legal government-to-government relationship with tribes through both executive action and legislation.

With regard to water, these relationships often revolve around environmental justice issues, water needs and water rights, water quality monitoring, or watershed management and restoration. Tribal members sit on state policy boards and advisory committees in order to provide perspective and guidance. These discussions range from awarding grants for restoration projects, to facility siting, to long-term water policy. As mentioned in Chapter 2, there is an ongoing need to resolve pre-1909 water right claims, including unresolved tribal claims.

Management of fisheries is an area where state and federal agencies work closely with tribal governments. In the Columbia River Basin, the Oregon Department of Fish and Wildlife works with the Columbia River Treaty Tribes (Nez Perce, Umatilla, Warm Springs, and Yakama), the Shoshone-Bannock Tribe, state fish and wildlife agencies in Washington and Idaho, the U.S. Fish and Wildlife Service, and the National Oceanic and Atmospheric Administration on a variety of fisheries management and fish production issues under the *2008 - 2017 U.S. v. Oregon, Management Agreement.* The Agreement was developed and is being implemented under the ongoing supervision of the U.S. District Court in Portland, Oregon. Species managed under the Agreement include white sturgeon, Chinook, Coho and sockeye salmon, walleye, lamprey, shad, and steelhead.

Partnerships with Neighboring States

Oregon shares surface water resources—the Snake River, the Columbia River, and the Klamath River, for example—with its neighboring states. It also shares significant groundwater aquifers with its neighbors, and coordinates data collection and sharing so that water managers on both sides of our borders can manage the resource effectively.

Oregon has been engaged in discussions with the State of Washington to pursue opportunities to release water from existing water storage facilities in Washington to offset additional water use in Oregon. These opportunities could also include potential long-term investment partnerships between the two states to construct new above-and below-ground storage facilities. Proposed appropriation of new water sources would be limited to times when water is available under existing state and federal requirements.

United States, Canada, and Tribes: Columbia River Treaty

The Columbia River Treaty between the United States and Canada was established in 1964, bringing significant flood control and power generation benefits to both countries. The year 2024 marks the end of 60 years of pre-paid flood control space from Canada. Either Canada or the United States can terminate most of the provisions of the Treaty any time on or after Sep. 16, 2024, with a minimum of 10 years written advance notice, making 2014 another important benchmark for this Treaty.

The U.S. Army Corps of Engineers and the Bonneville Power Administration, the agencies responsible for implementing the Treaty on behalf of the United States, are conducting a multi-year effort to study these post-2024 Treaty issues. This effort is called the 2014/2024 Columbia River Treaty Review. Stakeholders have embarked on a campaign to elevate the subjects of water supply and ecosystem needs into the top tier of discussion items.

Oregon, California, and Tribes: Restoration Agreements

Representatives from Oregon and California, including several federal agencies, tribal governments, counties, irrigators and conservation and fishing groups signed the Klamath Basin Restoration Agreement and Klamath Hydroelectric Settlement Agreement in February 2010. These agreements set signatories on a path to comprehensive solutions for the Klamath Basin.

Recommended Action 9.C
Partner with Federal Agencies, Tribes, and Neighboring States in Long-Term Water Resources Management

How to implement this action:

- Protect Oregon's interests in shared surface water and groundwater basins
- Partner to improve access to additional stored water

The Restoration Agreement is intended to: 1) restore and sustain natural fish production and provide for full participation in ocean and river harvest opportunities of fish species throughout the Klamath Basin; 2) establish reliable water and power supplies which sustain agricultural uses, communities, and National Wildlife Refuges; and 3) contribute to the public welfare and the sustainability of all Klamath Basin communities. The Hydroelectric Settlement lays out the process for additional studies, environmental review, and a set of decisions by the Secretary of the Interior regarding the removal of four PacifiCorp dams.

CRITICAL ISSUE: WATER MANAGEMENT AND DEVELOPMENT


Irrigation near Dufur, Oregon


New Plantings along Newton Creek, Benton County


Recycled Water Project in Newberg, Oregon

Photos: B. Wood, OWRD; D. Schmitz, Benton SWCD; P. Chiu, City of Newberg

To meet its water needs, Oregon has developed several helpful management tools. The techniques and tools discussed in the Strategy should be considered and evaluated as part of any place-based planning effort in order to address Oregon's instream and out-of-stream water needs as effectively as possible.

Several such tools are highlighted in this section for further development: water right transfers, field-based expertise, water-use efficiency and conservation, built storage, water reuse, non-traditional techniques, and water supply development.

Water Right Transfers

There is growing interest in the use of the water right transfer process as a tool to move water to support new out-of-stream uses, streamflow restoration, and economic growth. This interest is driven by the fact that most of the surface water in the state has already been allocated, which means the chances of securing additional water through a new water use permit are slim. This is especially true for obtaining water during the summer, when demands are high and supplies are scarce.

The Water Resources Department receives about 250 transfer applications for out-of-stream uses and about half a dozen applications for transfers to instream uses annually. The filing of transfer applications has steadily increased during the past twenty years, a growing trend in most western states. The program includes options for permanent transfers, temporary transfers, and instream leases. The Allocation of Conserved Water Program, discussed here shortly, is an innovative conservation tool available in the water right transfer program.

Field-Based Expertise

A number of natural resource agencies have personnel in the field. The ability to partner with the community and work on the ground is one area that sets Oregon apart from other states who have written policies, but limited capacity to implement or enforce them out in the field. The State's ability to identify and correct problems in water management is dependent on the number of skilled personnel in the field, the technical training they receive, the equipment (measurement, communications, and transportation) available to them, and their ability to educate and inform customers.

Field personnel collect data and protect public and environmental health through inspections and enforcement actions. They are well positioned to work with federal and local water managers, watershed councils, local planners, county commissions, and other entities in the community with responsibility for water. These individuals are also on the front lines of public education and they have a breadth and depth of policy, technical, and legal knowledge in their disciplines.

In recent years, however, the number of personnel in the field has dwindled. For example, staff at the Water Resources Department peaked in the 1990s when the agency had more than 160 staff members. This was supplemented by 37 county-funded assistant watermasters. In recent years, state-funded staff has declined to 144 and counties now support only 15 field-related positions. This reduction in the State's field presence is significant, given the large responsibilities involved. In southeast Oregon, for example, the District 9 watermaster is responsible for regulating and distributing water in an area covering 11,000 square miles. In northwest Oregon, the District 16 watermaster oversees several hundred dams of various sizes and configurations that need routine inspection and site visits.

There is a strong need to increase and maintain field presence among the state's water-related agencies. These staff members include watermasters, inspectors, scientists and technicians. Field personnel distribute available water to water rights; ensure compliance with permit conditions; guard against waste, contamination, and loss of artesian pressure; inspect for hazards; and collect critical data. Strengthening Oregon's field-based work will require financial investments and a look at more efficient ways to coordinate and partner with other agencies to carry out our shared responsibilities.

Water-Use Efficiency and Water Conservation

One of the more widely recognized approaches to managing water supplies is water conservation. Water conservation, as defined in state law, is a means of eliminating waste or otherwise improving the efficiency of water use by modifying the technology or method of diverting, transporting, applying or recovering water. This section notes many of the programs and funding resources that exist today, and makes a number of recommendations for improving access to information and program participation.

Water Conservation within the Home

Water conservation is a tool that can be implemented in any water use sector, and much has already been done to conserve water within our homes and businesses. Replacing certain appliances, such as toilets, dishwashers, and washing machines with more water efficient models, or adding faucet aerators to bathroom and kitchen sinks, or installing low flow showerheads to use less water are fairly common activities today. Land management techniques, such as maintaining healthy soils, planting drought-tolerant or native plants, and watering landscapes and plants when temperatures are cooler are also actions that can help conserve and make the best use of water resources.

WaterSense labeled faucets and accessories can conserve water by 30 percent or more.

WaterSense, a partnership program started by the U.S. Environmental Protection Agency in 2006, offers a quick and simple way to find water-efficient products, and services. A WaterSense label means a product has been certified to be at least 20 percent more efficient. Since the program's inception, it has helped consumers save a cumulative 125 billion gallons of water and $2 billion in water and energy bills.

Water Conservation within Agriculture

Agriculture is the largest user of water in Oregon, diverting an estimated 85 percent of the total water diverted in the state. Statewide efforts should focus on increasing voluntary conservation and efficiency efforts in the agriculture sector. This could result in significant water savings statewide.

Agricultural operations have options available to use more efficient irrigation systems, including weather-based irrigation systems, moisture sensor controls, evapotranspiration-based water models, drip irrigation, lining canals or piping, or variable speed pumping. Several irrigation districts, particularly in Central Oregon, have improved their water delivery systems through lining and piping projects to better manage water supplies. See accompanying essay, following page.

Piping and Lining as a Water Conservation Technique

Open canals and ditches, traditionally used to convey water throughout much of the state, face a distinct disadvantage in locations such as Central Oregon, where porous volcanic rock has caused significant leakage and water loss from open and unlined irrigation canals. Open canals also pose public safety issues and their maintenance can be costly and time-consuming, making it even more attractive to consider piping and lining for its multiple benefits.

Between 1992 and 2002, the U.S. Bureau of Reclamation engaged in a formal study to evaluate which piping and lining techniques and technologies fared favorably in Central Oregon's harsh weather conditions and rocky terrain. The cost-benefit analysis concluded that for all lining alternatives, every $1 spent on maintenance returns $10 in conserved water by increasing effectiveness and design life. Reclamation calculated these savings by assuming $50 per acre-foot for the value of the conserved irrigation water.

Reclamation cautioned that water leaking from unlined canals may be providing value for environmental, domestic, and irrigation uses, requiring thorough assessments before undertaking any changes. For example, seepage from canals may contribute to groundwater, rivers, and wetlands and these impacts should be assessed prior to canal lining. This type of assessment may be mandated for projects seeking federal funding.

Kevin Crew,
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Piping and Lining Open Canals in Central Oregon

During the past 15 years, there has been a greater emphasis on water conservation and river flow enhancement projects, especially in the arid Central Oregon region. Irrigation districts have been actively pursuing piping and lining projects to eliminate losses into the porous rock along many of Central Oregon's open canals. Piping and lining projects are key conservation measures of many irrigation districts' Water Management and Conservation Plans.

Recent conservation projects include the following:

- North Unit Irrigation District piped and lined more than 22 miles of canals, returning conserved water to the Crooked River and helping prevent fine sediments from discharging to sensitive habitats.
- Three Sisters Irrigation District piped a large portion of its district, conserving water and enhancing anadromous fish flows in Whychus Creek, a tributary of the Deschutes River.
- Central Oregon Irrigation District has installed a 2.5 mile pipeline that serves multiple benefits, including the conservation of 20 cfs, and the placement of water back into the Deschutes River.
- Tumalo Irrigation District enclosed four miles of its Bend Feed Canal, conserving approximately 20 cfs of water, with more than 17 cfs of the conserved water protected instream in Tumalo Creek.
- Swalley Irrigation District piped 5 miles of canal, conserving 30 cfs of water to benefit the Deschutes River.

Although some barriers to water conservation exist, there are several water conservation and efficiency technologies already in use that are particularly helpful to agriculture. The 2008 farm and ranch irrigation survey shows Oregon growers irrigated an estimated 1.65 million acres of cropland, of which more than 525,000 acres (almost one-third) are under central pivot, computer controlled, low-medium pressure, with soil moisture monitoring—some of the most sophisticated and efficient water-to-plant irrigation systems in the world.

Other irrigation approaches in Oregon include:

Traveling Big Gun: Oregon irrigators are known for "traveling gun" systems that spray a huge stream of water across a field. While susceptible to wind and evaporation losses, these motor-driven carts are the method of choice for oblong or odd-shaped fields on small acreages such as berry fields, and for delivering effluent water from dairies, applied as nutrients on pasture and feed crops. More than 93,000 acres in Oregon are irrigated this way—more than any other state.

Drip or Micro Sprinklers: Oregon also ranks high in drip-irrigation, trickle or low-flow micro-sprinkler systems. Approximately 1,600 farms irrigate 81,000 acres by these methods.

Recycled Water: Oregon ranks fourth of all states in recycled and reclaimed water used for irrigation on more than 77,000 acres. Oregon ranks 5th of all states for the amount of food crops (square footage) grown in greenhouses, hoop houses, or other protected environments.

Flood Irrigation: Dominant on pasture, grazing lands, and some vegetable crops, 670,000 acres are irrigated with controlled or uncontrolled flood systems in Oregon.

The 2008 irrigation survey also shows Oregon producers applying, on average, 1.9 acre-feet of water per acre to grow their crops. This ranks very well compared to other surrounding states. Washington applies 2.3 acre-feet, Idaho applies 1.9 acre-feet, and California applies 3.1 acre-feet per acre, each year.

Challenges to further improving water conservation within agriculture can include the potential for increased energy-related costs, lack of funding or technical assistance, or a fear of forfeited water rights ("use it or lose it," as it's commonly called). The potential for reduced return flow or injury to other water users are also factors to consider when designing a water conservation project.

A number of resources exist to help water users make efficiency gains. The Bureau of Reclamation offers competitive grants to facilitate agricultural water planning. Other funding sources include the U.S. Department of Agriculture's Natural Resources Conservation Service, Oregon Water Resources Department feasibility grants, and the Oregon Department of Energy's tax credits for efficiency-upgrades.

Allocation of Conserved Water Program

Oregon's Allocation of Conserved Water Program allows a water right holder who plans to implement a water conservation project to legally use a portion of the conserved water on additional lands, while another portion is permanently protected instream. Examples of eligible conservation projects include lining or piping open leaky canals or ditches, or changing a less efficient water distribution system, such as flood irrigation, to sprinkler or drip irrigation.

Since the program began, fifty-two conservation projects have been approved under this program. This has resulted in almost 122 cfs of water permanently protected instream. Recent surveys show that very few irrigators and technical irrigation experts are even aware of this program, or the benefits to instream flows and agricultural production. The few irrigators who are aware of the Allocation of Conserved Water Program have realized huge benefits, placing more than 5,100 acres of previously arid land into cultivation. The Strategy should focus efforts on improving awareness of programs such as this. Increased participation in these programs could benefit both instream and out-of-stream needs.

Water Management and Conservation Planning – Agricultural and Municipal Uses

The water management and conservation planning process is an opportunity for municipal or agricultural water providers to estimate long-range water supply needs, and identify potential sources of supply, including water conservation programs, to meet those needs.

The Water Resources Department provides a template for municipalities to follow as they develop these plans, and requires municipal water suppliers to prepare plans as conditions of their water use permits or permit extensions. A municipal Water Management and Conservation Plan, or "WMCP," provides a description of the water system, identifies the sources of water used by the community, and explains how the water supplier will manage and conserve supplies to meet future needs.

The Department coordinates a similar, voluntary program for agricultural planning, and provides a template for these plans as well. By using this process, irrigation districts and other suppliers can create a "water budget" for their current and future needs. Application of appropriate conservation tools may also lead to an increase in available water supplies to better meet their patrons' crop demands. Irrigation districts with plans approved by the Water Resources Department are able to take advantage of statutory provisions that allow the transfer of water rights from one district user to another to prevent forfeiture of the rights due to non-use.

Oregon should encourage greater participation by agricultural producers and providers in the State's water management and conservation planning program.

Water Conservation within Municipalities

One trend that has emerged in recent years has been decreased water demands across several of Oregon's urbanized communities. Water providers in the Portland Metro area indicate that water demands from some utilities have decreased by approximately 20 percent since 2008. It is difficult for the water providers to determine the exact cause of the demand decreases, but it is likely a combination of multiple factors, among them, recent wetter/shorter summers, loss of industry, and water conservation programs taking effect.

The Water Resources Department often requires water utilities to examine conservation-based rate structures. As a result, some utilities have modified their water rates, further driving down demands for water. In a 2009 survey conducted by the League of Oregon Cities, 37 percent of member cities reported the use of inclining block rates, the rate structure typically used to effect water conservation behavior.

Recommended Action 10.A
Improve Water-Use Efficiency and Water Conservation

How to implement this action:

- Establish and maintain an online water-use efficiency and conservation clearinghouse
- Prioritize agricultural water-use efficiency
- Expand outreach and participation in the State's water-use efficiency and conservation programs
- Conduct a state-wide water conservation potential assessment 🕮

Many water providers in Oregon offer rebates for the purchase and installation of water efficient appliances; some also provide shower timers, leak detection kits, and water conservation consultations free of charge to their customers. The State's water management and conservation planning program has been used by many of these water providers to successfully identify water conservation measures, such as those described here.

Identifying Additional Opportunities for Water Conservation and Efficiency

Oregon and its water providers have many programs and tools available to encourage water conservation and more efficient use of water resources. Establishing and maintaining a water-use efficiency and conservation clearinghouse that highlights best management practices, as well as state and federal funding sources, technical resources, and local conservation programs and tools, should be developed to help water providers design or improve their own programs. Conservation tools, such as those offered by the Alliance for Water Efficiency and the Water Research Foundation that help entities calculate the economic benefits of conservation programs, are good examples to feature in the clearinghouse. Having

analytical tools easily available is of critical importance in terms of determining whether investment in water efficiency and conservation programs make sense.

As for research needs, a statewide assessment that looks at the potential for water conservation would provide a quantitative basis for estimating how much water savings could be achieved with a variety of conservation best practices. A basin-by-basin hydrologic assessment of conservation's benefits and/or impacts on streamflows is another research need that could help the State and its conservation partners prioritize future efforts. This research would support previous agency work that identified stream reaches with the greatest need for streamflow restoration to benefit fish species.

Lastly, because water and energy are so closely tied, water conservation goals and efforts should be coordinated with energy efficiency programs.

Built Storage

The history of storing water in Oregon dates back to the 1800s when projects consisted mostly of ponds or small dams across streambeds. As the state's population grew, so did the scale and purpose of these projects. Before long, developers and governments were building major dams and reservoirs to meet the increasing water demands for power production, flood protection, and out-of-stream needs during the dry summer months.

In Oregon today, there are more than 15,000 water rights authorizing the storage of surface water. Most water rights are for small ponds or reservoirs storing less than 9.2 acre-feet, although there are more than 60 reservoirs with capacities exceeding 5,000 acre-feet each. The largest storage project is the U.S. Bureau of Reclamation's Owyhee Reservoir in southeastern Oregon with more than 1 million acre-feet (0.3 cubic miles) of storage.

In 1992, the Water Resources Commission adopted the state's water storage policy, identifying water storage options as an integral part of Oregon's strategy to enhance public and private benefits from use of the state's water resources. The policy acknowledges that both structural and nonstructural methods should be used in Oregon to store water, with preferences for storage that optimizes instream and out-of-stream public benefits and beneficial uses. In 1993, the Oregon Legislature codified the state's policy of water storage facilities, declaring it a high priority to develop environmentally acceptable and financially feasible multipurpose storage projects, and to enhance watershed storage capacity through natural processes using non-structural means.

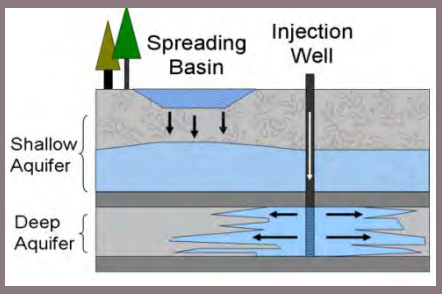
Below Ground Storage - Aquifer Storage and Recovery and Artificial Recharge

In 2008, the Water Resources Department evaluated 54 groundwater aquifers within Oregon and created a rating system to help assess the suitability of potential sites for underground storage.

The Department evaluated aquifers in terms of their physical ability to store water. The analysis did not include an economic or environmental feasibility analysis, only a hydrogeologic evaluation of how these areas accept and retain water. The most suitable locations are in the northern portion of Oregon, where geology, water availability, and cost-benefit circumstances create a favorable environment for this water management tool.

The use of Aquifer Storage and Recovery (ASR) and Artificial Recharge (AR) is gaining interest, particularly in the northwest and north central regions of Oregon, due to its smaller environmental footprint, cost, and associated benefits to water quality.

Authorizations for both of these processes are issued by the Oregon Water Resources Department in collaboration with the Department of Environmental Quality. DEQ's role is to ensure that a project meets standards for underground injection control systems, as well as underground water quality protection requirements. The Oregon Department of Fish and Wildlife is also involved when surface water is used as source water. ODFW consults with the Water Resources Department on permit conditions.



Methods of underground storage include infiltration into shallow aquifers through spreading basins or direct injection into deep aquifers using wells.

The Oregon Health Authority also plays a role in ASR/AR projects, ensuring that drinking water quality requirements are met. Water that is treated to standards safe enough for drinking water is the only source water allowed for direct injection into groundwater aquifers. Direct injection of water must be compatible with natural groundwater as well.

The following table describes both technologies in greater detail.

Category	Artificial Recharge	Aquifer Storage and Recovery
Water Use	Primarily irrigation, industrial	Primarily drinking water
Recharge Method	Seepage systems, injection wells	Injection wells only
Water Quality Requirements	Recharge water cannot impair or degrade groundwater quality	Recharge water must meet drinking water standards
Water-Rights	Permits required to appropriate source water and to pump recharged groundwater	Can use existing rights to store and recover the water
Governing Statutes /Rules	ORS 537.135 OAR 690-350-0120	ORS 537.531 to 537.534 OAR 690-350-0010 to 690-350-0030

The State has issued limited licenses to 18 entities for testing the use of Aquifer Storage and Recovery, including one ASR permit and five aquifer recharge permits. The reasons for aquifer storage range from municipalities that need to supplement their water supplies for their communities, as in the case of Baker City and the City of Beaverton, to farmers and ranchers, who can use the tool to supplement irrigation water during the summer months.

Oregon can improve access to built storage by encouraging the increased use of Aquifer Storage and Recovery and Artificial Recharge for water storage, where needed. Areas of the state designated as "groundwater limited" or "critical groundwater areas" should be evaluated for ASR and AR projects.

Forming partnerships between different user groups, for example, a municipality that treats water and an irrigation district needing an alternative source of water should be considered as a way to meet the water quality requirements for ASR injection.

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GSI Water Solutions, Inc.

Oregon Projects Use a Combination of Groundwater Storage Techniques

Umatilla Basin. The Umatilla Basin Aquifer Recovery Project uses artificial recharge techniques to clean the water to state water quality standards, and then injects the water into deep storage using aquifer storage and recovery techniques. Communities nationwide are following this project with interest, noting benefits to both irrigators and instream interests.

City of Beaverton. Since 1997, Beaverton has been implementing ASR to meet peak seasonal demands. The city has 6 million gallons per day of ASR capacity and has now drilled its fourth ASR well. During the past 14 years of operation, the ASR system has become an important element of Beaverton's overall supply (providing up to 25 percent of the peak supply) and has saved the City significant money by deferring a new water transmission line and eliminating the need to purchase water from Portland to meet peak demands.

Above-Ground Storage (Reservoirs)

Today, there is a mix of both publicly and privately owned above-ground storage reservoirs throughout Oregon. The largest of these are federal storage projects. There are some federal storage projects that are not fully allocated, representing key points of discussion between the State of Oregon and federal agencies. In the Crooked River Basin and the Willamette Basin, for instance, it can be difficult to secure long-term contracts, both instream and out-of-stream, for unallocated water.

Federal Reservoir Systems – In the Willamette Basin Reservoir System, the U.S. Army Corps of Engineers operates 13 dams and stores 1.6 million acre-feet of water in the reservoirs located on the Willamette River and its tributaries. Congress authorized the construction of these reservoirs for a variety of purposes, including flood control, navigation, generation of hydroelectric power, irrigation, potable water supply, and pollution reduction.

Recommended Action 10.B
Improve Access to Built Storage

How to implement this action:

- Develop additional below-ground storage sites
- Re-allocate water in federal reservoir systems that have not undertaken formal allocation processes in Oregon
- Develop additional above-ground, off-channel storage sites where needed
- Evaluate the status of storage infrastructure 🕮
- Authorize and fund the State to invest in and purchase water from stored water facilities

The U.S. Bureau of Reclamation currently holds water right certificates for 1.6 million acre-feet of storage for irrigation use, and is authorized to negotiate contracts with irrigators for that water. Other water interests in the basin, including municipal water providers and instream interests, would also like to have access to this stored water.

Similar conversations are occurring in the Crooked River Basin to manage uncontracted stored water in Prineville Reservoir to meet increasing demands for fish and wildlife, and other users. Prineville Reservoir, southeast of Prineville on the Crooked River, was built by the Bureau of Reclamation in 1960, and is currently authorized for irrigation and flood control only. A moratorium currently exists on long-term irrigation contracts out of Prineville Reservoir.

Reallocating water stored behind federal dams, such as in the Willamette Basin, could serve a full range of beneficial uses to meet agricultural, municipal, industrial, environmental, and recreational needs.

Developing contracting mechanisms that allow instream and out-of-stream water users access to such water, while protecting any contracts currently in place, would serve to make reallocation workable.

Identifying Storage Sites: The Water Resources Department maintains an inventory of potential water storage sites in Oregon. The purpose of developing the inventory was to create a clearinghouse of storage information. No attempt was made to assess the ecological or economic feasibility of these sites, however. The Department has provided this information so that communities can avoid "reinventing the wheel," in terms of site investigation.

To date, the Department has mapped the location of more than 1,200 potential above-ground storage sites. This information, collected over several decades, came from staff, other state, local, and federal agencies, private consultants, and the public. The Department has mapped each potential site and linked all available information to the project, including capacity curves, reservoir inundation areas, and site maps.

The State will continue to help water users identify potential above-ground storage sites, supporting the development of additional above-ground, off-channel storage opportunities, where needed, in locations where no known listed fish species exist.

Evaluating Storage Infrastructure: Oregon should evaluate the status of its existing storage capacity and infrastructure. Today, evaluation of storage infrastructure, including determining the maintenance and rehabilitation needs of dams, is done under Oregon's dam safety program. Continuing to support this program, and identifying ways to expand the capacity of existing above-ground storage projects (through raising a dam's height or sediment removal), is needed to improve access to stored water.

Water Reuse

Along with multi-purpose storage projects, the State of Oregon encourages the reuse of water, so long as the use protects public health and the environment. Interest in water reuse projects continues to grow in Oregon. The Oregon Association of Clean Water Agencies, for example, has identified recycled water use as a top priority for its members. Several agencies, including the Oregon Health Authority, Department of Environmental Quality, Oregon Water Resources Department, and the Oregon Department of Consumer and Business Services (Building Codes Division), are all involved in different aspects of water reuse projects and proposals.

The State of Oregon encourages three general categories of water reuse:

The Use of Graywater

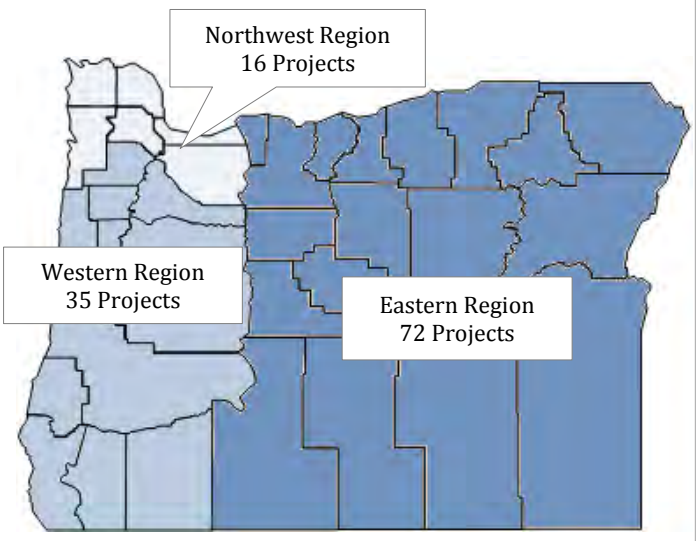
Graywater refers to water from showers, baths, bathroom sinks, kitchen sinks and laundries. Graywater can be reused for limited activities, such as subsurface irrigation, with minimal treatment. Homeowners and small businesses can reuse graywater for toilet and urinal flushing with the appropriate plumbing permit from a local building department. Outdoor reuse of graywater can occur by carefully planning reuse activities and obtaining a Water Pollution Control Facility graywater reuse and disposal system permit from DEQ.

The Use of Recycled Water

Recycled water refers to treated effluent from a municipal wastewater treatment facility. Oregon has approximately 340 domestic wastewater treatment facilities and there are more than 120 municipal facilities operating recycled water programs throughout the state (see map, following page).

Four classes of recycled water, based on various levels of treatment, can be reused for specific beneficial purposes. Communities are already taking advantage of State Revolving Fund loans for developing and upgrading recycled water systems, with seventeen such requests in 2009 alone.

Recycled Water Use Projects



~ Map courtesy of Oregon DEQ

The Use of Industrial Wastewater

Industrial wastewater refers to treated effluent from an industrial process, manufacturing or business, or from the development or recovery of any natural resource. An example of industrial wastewater is water derived from the processing of fruit, vegetables, or other food products.

Although water reuse activities are limited to non-drinking water purposes, a wide-range of activities can occur, including irrigation of crops and pastureland, irrigation of urban landscapes (e.g., golf courses, playing fields, and business parks), industrial cooling, dust control, street sweeping, and artificial groundwater recharge.

Specific water reuse activities depend on the water treatment and resulting quality. More reuse activities can occur with higher-quality water. As treatment technologies improve and public awareness of water reuse benefits increase, more innovative and urban uses of water will become more common.

Recommended Action 10.C
Encourage Additional Water Reuse Projects

How to implement this action:

- Conduct a statewide assessment of the potential for additional water reuse 🕮
- Ensure that Oregon has the right policies and regulations in place to facilitate water reuse
- Provide incentives for increased water reuse

Reusing water can provide many benefits to both water quantity and quality. Water quality can be improved by the reduction of discharged treated effluent (e.g., a municipality recycles treated wastewater by using it to irrigate a park). It can also provide a benefit to water quantity by reducing the demand on drinking water sources (e.g., using non-potable water—instead of drinking water—for toilet flushing). In general, recycled water places fewer demands on freshwater, leaving more water instream or for other uses.

Finding More Reuse Opportunities

Oregon should continue to encourage water reuse activities throughout the state. This can be done, in part, by conducting a statewide assessment of the potential for additional water reuse, matching the water quality of reclaimed water to appropriate end uses. Such an assessment could determine the potential for water reuse to fulfill current and future water needs, while taking into consideration potential impacts on streamflow and water quality.

Water reuse could also be advanced by ensuring that Oregon has the right policies and regulations in place to facilitate water reuse, giving due consideration to the protection of instream flow, water quality, public health, and drinking water sources. Oregon should also consider providing financial or technical incentives for increased water reuse for municipal, industrial, and agricultural uses.

Non-Traditional Approaches to Meeting Water Needs

Storage and water conservation are a set of traditional tools for meeting water needs and water reuse is another tool that is growing in popularity. These traditional water supply tools are used in conjunction with state and federal regulatory tools that protect water resources for future generations. Today, however, we also need to consider less traditional approaches to meeting our collective and often competing demands for water. A number of public entities and non-profit organizations are already exploring and implementing non-traditional approaches to meeting water quality, water quantity, and ecosystem needs.

Clean Water Services, Tualatin River Watershed

Clean Water Services, a public utility serving Washington County, treats wastewater and releases it back into the Tualatin River. The utility is required to reduce the water temperature of its discharge to certain levels to protect fish in the river.

In 2004, the Oregon Department of Environmental Quality issued the Nation's first watershed-based, integrated NPDES permit to Clean Water Services, allowing the utility to invest in riparian shade restoration within the watershed to meet the temperature discharge requirements.

By planting trees to shade and prevent warming of the river's temperature, Clean Water Services completely avoided the traditional, yet more expensive option of purchasing refrigeration units at an estimated $60 million, plus an additional $2 million per year for operation and maintenance needs. More than 4 million native plants and shrubs have been planted along the river and its upper tributaries, equal to approximately 50 miles of river at an estimated cost of $4.5 million. Clean Water Services is able to invest a portion of its cost savings in strategies that lead to greater ecological benefits in the watershed while still achieving regulatory water quality requirements.

Recommended Action 10.D
Reach Environmental Outcomes with Non-Regulatory Alternatives

How to implement this action:

- Assist in the research and development of non-regulatory tools to meet environmental outcomes
- Develop protocols for translating water quality projects into credits 🕮
- Develop protocols for translating streamflow restoration into credits and accounting strategies 🕮
- Complete stream functional assessment

Next Steps

Public and private partners throughout Oregon are currently looking for ways to enhance tools that will help achieve desired environmental outcomes. Further assessment is needed to determine the potential for different types of ecosystem restoration projects for meeting various regulatory goals, including temperature and nutrients under the Clean Water Act as well as species habitat needs under the Endangered Species Act. This includes developing protocols to quantify and then translate the benefits of these restoration actions into some form of tradable currency. Organizations such as The Freshwater Trust, the Willamette Partnership, and the National Fish and Wildlife Foundation are actively working on developing protocols.

These protocols will help DEQ and point and non-point source dischargers make more informed choices about how to meet water quality requirements in more cost-effective ways (e.g., using riparian shade restoration to help achieve heat reduction requirements).

There are also tools and protocols for translating flow restoration actions into temperature, nutrient, and other types of credits. Water quality projects designed to meet temperature goals are currently occurring in several locations throughout Oregon. Oregon's state agencies will continue to provide technical

assistance to partners during the development of protocols to translate flow restoration into temperature credits.

Another way to reach desired environmental outcomes is to build upon the "stream functional assessment" under development by the Oregon Department of State Lands, the U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, and other partners to include streamflow in function-based accounting strategies.

David Pilz,
The Freshwater Trust

City of Medford, Rogue River Basin

Clean Water Services' work in the Tualatin Basin set the stage for developing a rigorous, statewide, and agency-adopted protocol for water quality trading to meet water quality goals. This protocol expanded the opportunity to invest in stream restoration projects as an alternative to traditional, engineered solutions, such as water refrigeration, to meet water quality goals across the entire state of Oregon. With this protocol in place, the Pacific Northwest is poised to make water improvements via stream and habitat restoration a viable, efficient way for towns and facilities to meet limits on temperature, nitrogen and phosphorus, while creating jobs and improving local watersheds.

The City of Medford and its partners evaluated the practicality of restoration offsets to meet the new temperature discharge requirement for the Rogue River. The Freshwater Trust proposed a water quality trading program in which the City could purchase temperature credits generated from privately-financed riparian restoration projects. Over time, trees planted within a regulator-defined area near the wastewater treatment facility would shade and prevent warming of the water, offsetting the impacts of the plant's clean but warm discharge.

The analysis included estimates of temperature credits required, analysis of available land for restoration, total cost, and implementation procedures. With this analysis in hand, Medford's managers could make a direct "apples-to-apples" comparison of their options, including restoration — a first for National Pollutant Discharge Elimination System (NPDES) permit evaluations anywhere in the country.

At the end of the analysis, the City selected the water quality trading alternative. The decision centered on four components: support for water quality trading from DEQ; temperature credits costing half of the best-engineered solution; associated ecological benefits, and lastly, responsibility for landowner recruitment, project management, and meeting regulatory standards on offsets would fall upon a restoration-focused organization. These efforts in the Rogue River basin have prompted a formal aligning process among all Clean Water Act management agencies in the Pacific Northwest (EPA, Oregon DEQ, Idaho Dept. of Environmental Quality, and Washington Department of Environmental Quality).

Water Supply Development

Other western states, particularly neighboring California and Washington, have long had authorities in place, allowing the state to take an active role in the development of water supply to benefit both instream and out-of-stream uses.

Through discussions with federal and other partners, the Water Resources Department has become aware of potential opportunities to purchase stored water, invest in, and develop new water resources projects. These opportunities may occur in the Columbia, Willamette, Rogue, and other basins, through

arrangements with the U.S. Army Corps of Engineers, U.S. Bureau of Reclamation, and other partners. Today, the State of Oregon has neither the authority to enter into such arrangements, nor the funding to purchase, invest in, or develop such opportunities.

The establishment of a water supply development program would improve the state's ability to assess, plan, and develop new multi-purpose storage, including above and below-ground storage, to improve or expand operations of existing storage facilities, to implement conservation projects, or to facilitate other actions designed to provide access to new water supplies for instream and out-of-stream uses in Oregon. Such a program would necessarily work in tandem with a place-based planning approach, with state and local partners working together to determine needs, feasibility, funding, and implementation.

Recommended Action 10.E
Authorize and Fund a Water Supply Development Program

How to implement this action:

- Identify opportunities for the State to serve as a partner in water supply development projects
- Authorize the Water Resources Department to invest in projects, to purchase and/or contract for water supplies
- Authorize bonds to finance these investments

CRITICAL ISSUE: HEALTHY ECOSYSTEMS

East Fork Illinois River, Josephine County

Rogue River Gorge, Jackson County

John Day River, east of Kimberley, Grant County

Photos: Gary Halvorson, Oregon State Archives

Responsibility for managing, protecting, and restoring Oregon's ecosystems falls across a broad range of local, state, tribal, and federal agencies, as well as on private landowners and local organizations. Oregon has a rich history of work in this area, using myriad tools and institutions to help address and improve ecological conditions.

Healthy ecosystems provide a wide variety of benefits and services to our communities. Generally, the term "ecosystem" refers to a system of interdependent relationships between organisms and their surrounding environments. Oregon's ecosystems sustain economically viable activities such as farming, ranching, fisheries, timber harvesting, power generation, and outdoor recreation, while providing high quality water, carbon sequestration, flood control, fish and wildlife habitat, and productive soils.

By degrading or neglecting functioning ecosystems, we risk jeopardizing our own quality of life as well as the fish and wildlife that depend on these systems. This degradation subsequently results in a need to engineer solutions that mimic ecological functions, often at a great expense. For instance,

- It costs far more to obtain drinking water when treated by a multi-million dollar facility than maintaining a relatively healthy watershed that naturally provides a source of water;

- Flooding is far more frequent and costly when waters cannot be well absorbed by the physical environment;
- Crop production costs are higher when soil productivity is compromised; and
- Fish populations are more expensive to maintain through restoration actions and hatchery operations than through the maintenance and protection of natural habitat and watersheds.

The Relationship between Water and Resilient Ecosystems

Resilience is the capacity to absorb and adapt to disturbance and change—while maintaining essential functions. Healthy water resources are directly related to the resiliency of an ecosystem. This section describes the important role that natural storage systems play in Oregon's ecosystems and makes several recommendations for further improvements.

Freshwater Ecosystems

Freshwater ecosystems are essential for providing habitat to many at-risk species, including important spawning and rearing habitat for salmonids, breeding habitat for amphibians, and habitat for freshwater mussels and other invertebrates. However, most river systems in Oregon have been heavily modified in order to achieve various flood control, irrigation, navigation, hydropower, recreation, and other water supply benefits.

A riparian area is the zone of transition from an aquatic ecosystem to a terrestrial ecosystem. These areas are located adjacent to lakes, reservoirs, estuaries, wet meadows, and streams. Riparian areas represent about 15 percent of the total area in the state. They are dependent upon surface or subsurface water through the zone's soil-vegetation complex to support the overall health of the riparian ecosystem. Wetland habitats are highly diverse and include the following different types: alkaline wetlands, deciduous swamps and shrub lands, marshes (including emergent marshes), playas, seasonal ponds and vernal pools, wet meadows, and wet prairies. Floodplains, also diverse habitats, are the land areas adjacent to a river, stream, lake, estuary, or other water body that is subject to flooding. These areas, if left undisturbed, act to store excess floodwater.

Recommended Action 11.A
Improve Watershed Health, Resiliency, and Capacity for Natural Storage

How to implement this action:
- Improve riparian conditions
- Preserve wetlands
- Restore floodplain functions
- Maintain forested areas

Through their ability to hold and slowly release water, filter and biologically process nutrients, and to provide shade and habitat, upland wet meadows, riparian wetlands, and floodplain habitats directly affect water storage, hydrology, water quality, habitat quality, and water temperature.

Oregon has lost an estimated 38 percent of its original wetlands. In the Willamette Valley, a recent study shows an average loss of wetlands at the rate of 357 acres per year, between 1994 and 2005. In the Willamette River Basin, flood control modifications have largely disconnected the Willamette River from its braided channels, oxbows and sloughs—wetland types that characterized much of its historical floodplain. This fundamental change of the valley's hydrologic regime has changed the character of the valley's wetlands and greatly altered their functions.

The Strategy should continue to encourage efforts to improve riparian conditions through voluntary restoration, such as the efforts conducted under the Oregon Plan for Salmon and Watersheds and Oregon's Agriculture Water Quality Management Plans. The State already provides incentives for voluntary participation in these restoration-type projects, including funding and technical assistance.

Developing a statewide floodplain policy could set the framework for regulation and permitting of floodplain restoration. Oregon should also support other ways to restore floodplain function, including implementation of actions described in Oregon's Conservation Strategy, such as reconnecting rivers and streams to their floodplains; restoring stream channel location and complexity; removing dikes and revetments; allowing seasonal flooding; restoring wetland and riparian habitats; and removing priority high-risk structures within floodplains.

Estuaries

An estuary is a zone of transition between the marine-dominated systems of the ocean and the upland river systems, a zone which yields one of the most biologically productive areas on Earth. Estuaries provide important habitat for many fish and wildlife species for rearing, nesting, foraging, and as a migration route. Numerous species can be found in Oregon's estuaries, such as salmon, herring, flounder, crabs, oysters, clams, birds, ducks, geese, shorebirds, and harbor seals.

There are 22 major estuaries in Oregon; the Columbia River estuary at Astoria is the largest in area at approximately 80,811 acres, although most estuaries along the coast are relatively small. Some of the issues affecting the health of Oregon's estuaries include increased sedimentation and nutrient loading, introduced nuisance species, recreational and development pressures, and low freshwater inflows.

Groundwater & Ecosystems

Groundwater dependent ecosystems support a large number of plants and animals and offer multiple benefits to humans, such as clean water and recreational opportunities including river rafting, and wildlife/bird watching. Many cold-water salmonids thrive in Oregon because of the high quality and quantity of water supplied by springs and groundwater, due to a large extent to the unique geology of Oregon.

Groundwater is susceptible to contamination from many different pollutants, including nitrates, especially where the water table is shallow and there are no confining units to reduce migration downward. If the contaminated groundwater flows into streams and rivers, it can cause elevated nitrate levels in downstream water bodies, posing problems for groundwater dependent ecosystems and water users. An assessment of groundwater dependent ecosystems was completed by The Nature Conservancy in 2011 (see brief description featured on page 43).

Forests

Oregon is comprised of 61 million acres of land. Nearly 50 percent of the state, or 30 million acres, is classified as forestland. Oregon's forests help filter drinking water, keep water cool, provide habitat for diverse animal and plant species, supply oxygen, moderate temperatures and rainfall, and store atmospheric carbon. Healthy forests promote soils that provide natural filtration to keep streams clean and water quality high.

Most of Oregon's municipal water systems use water that originates from forestlands, including those managed for wood production. The quality of this source water is among the best in the nation. At the state scale, data collected by DEQ between 1998 and 2007 indicates that more than 90 percent of the sampled sites on forestlands showed an Oregon Water Quality Index in good or excellent condition.

Forests are part of the essence of Oregon, and our waters benefit from their sound management. However, Oregon's forests are at risk. For example, many federal forestlands, particularly in drier regions, have massive ecological restoration needs. The density of homes in private forests has doubled in the last decade. Forests are being fragmented, converted to other uses, and encroached upon by development. The rising expense of owning forestland and the land's growing value as real estate create increasing pressure to sell private forestland for development.

There are solutions. Forest diversity can offer a range of benefits when land managers emphasize multiple values—wood production, nature emphasis, or mixed uses. Awareness is growing that keeping forests in productive forest use should be a primary goal. Keeping forests as forests requires public support and investment in forestry and resource protection policies that make continued forest ownership an economically viable alternative to conversion. The Forestry Program for Oregon emphasizes this, and the Strategy should continue supporting efforts to maintain healthy, resilient, and functional forested areas, in part, for the benefit of water resources.

Enhancing Streamflows

In many areas of Oregon, streamflows are very low or even non-existent during late summer months. Today, low streamflow conditions occur during periods of drought, intensive water use, and may be exacerbated by changes in precipitation patterns. Low streamflows often mean higher water temperatures and increased nutrient concentrations, contributing to poorer water quality. Changes in the hydrologic regime, improperly sized or misaligned culverts, and impassable dams have greatly reduced historically accessible habitat for many aquatic species. Oregon needs to enhance streamflows by developing additional instream protections and expanding the scope and scale of its tool box.

Instream Water Rights

Oregon should help meet instream needs by establishing additional instream water rights, where needed, to protect both base and elevated flows, and continue to work on resolving protested instream water right applications. Coordination of these new instream water right applications is needed to meet multiple water quality and flow needs. For example, when the Oregon Department of Fish and Wildlife is preparing to apply for an instream water right, it can coordinate with the Oregon Department of Environmental Quality and the Oregon Parks and Recreation Department to submit a joint application (if warranted) to address multiple instream needs and run simultaneous public processes.

Recommended Action 11.B
Develop Additional Instream Protections

How to implement this action:

- Establish additional instream water rights where needed to protect flows
- Designate scenic waterways where needed to protect recreation, fish, and wildlife uses
- Expand the use of voluntary programs to restore streamflow
- Expand the geographic range of flow restoration efforts

At the completion of a TMDL, the Department of Environmental Quality has the opportunity to prepare and submit to the Water Resources Department an instream water right application for the flow amount used to calculate the TMDL.

The Oregon Parks and Recreation Department has the authority to recommend the designation of additional rivers or segments of rivers as scenic waterways, or file for instream water rights, where needed, to protect recreation, fish, and wildlife uses. Oregon has one of the most extensive scenic waterway systems in the country, with more than 1,100 river miles protected for the beneficial uses of recreation, fish and wildlife. The designation of scenic waterways is a well-established tool that brings benefits to a local economy through tourism and recreation, while at the same time protecting water quality and quantity and other ecological values. The last state-designated scenic waterway was established in 1989.

Instream Transfers & Leases

Not only can state agencies apply for water rights to protect water instream, water users with existing water rights can transfer water instream using several tools and programs administered by the Oregon

Water Resources Department. Water users can voluntarily transfer their out-of-stream use, such as irrigation for agricultural crops, to instream use, on a temporary or permanent basis. The water user has the option of transferring an entire water right instream, or a portion thereof.

Oregon is a leader in flow restoration. More than 300 current instream leases, instream transfers, and conserved water projects have resulted in the restoration of nearly 1,700 cubic feet per second of water instream for the benefit of fish, wildlife, recreation, and water quality.

More than 70 percent of the water that is transferred instream by water users on a permanent basis is senior in priority, with some certificates pre-dating Oregon's 1909 water code. One of the basic tenets of instream transfers is ensuring that other water users are not injured as a result of the changes to the use.

The instream program benefits greatly from active partnerships with Oregon's conservation organizations, including The Freshwater Trust, the Deschutes River Conservancy, and the Klamath Basin Rangeland Trust. Incentives offered by these organizations and others can help landowners remain productive and profitable, while also benefitting freshwater ecosystems. Instream flow restoration activities have predominantly occurred in a handful of basins, although streamflow restoration needs have been identified in every basin throughout the state. Developing and implementing strategies that target watersheds with the highest instream flow needs is needed to expand voluntary streamflow restoration beyond current efforts, on both public and private lands.

Preventing the Spread of Invasive Species

According to the Oregon Invasive Species Council, an invasive species is a non-native species that can cause economic or environmental harm or cause harm to human health. It can be a plant, animal or any other biological viable species that enters an ecosystem beyond its native range. Invasive species disrupt the natural function of an ecosystem by competing and replacing native species and disrupting the natural habitat. Oregon's rivers, lakes, and streams are greatly affected by their presence.

Zebra Mussel; photo: Randy Westbrooks

In 2011, the Oregon State Marine Board and the Oregon Department of Fish and Wildlife implemented the second year of the Aquatic Invasive Species permit program, which included watercraft inspection stations and decontamination washes in locations throughout Oregon. Inspection teams conducted 3,600 inspections and intercepted six boats with zebra/quagga mussels; three were from Lake Michigan, one was from Lake Mead, one was from Lake Havasu, and one was a sailboat from the East Coast.

Built systems are also negatively affected by invasive species. Invasive species can interfere with water use by reducing flow in irrigation canals and drainage ditches, which can result in flooding and damage to canal banks, structures and pumps. Water treatment and power plants are also affected by invasive species, which can cause problems in water intake pipes, filtration equipment, and generation plants.

Certain species of cyanobacteria, commonly referred to as blue-green algae, can be both invasive and toxic. It can form thick foam or scum on the water's surface and produces toxins or poisons that can cause serious illness or death in pets, livestock, wildlife and humans. Some of Oregon's lakes and reservoirs are experiencing annual blue-green algae outbreaks.

Invasive species are already very costly to Oregon's economy. A 2009 report on the economics of invasive species estimates the impacts from 21 noxious weed species in Oregon at $125 million per year, and the control costs of the current sudden oak death outbreak to be $7 million annually.

Oregon's state agencies and partners should support implementation of the Oregon Conservation Strategy's six statewide actions aimed at preventing new introductions of invasive species, and slowing the scale and spread of infestations. This can be achieved by coordinating the efforts of public agencies and private citizens, including the use of boat inspection stations.

In addition, implementing and enforcing ballast water management regulations is needed to reduce the risk of introducing new aquatic invasive species. The discharge of ballast water, used to provide vessel stability, may introduce aquatic non-indigenous species into Oregon waterways, potentially resulting in ecological damage, economic costs, and/or human health concerns.

Recommended Action 11.C
Prevent and Eradicate Invasive Species

How to implement this action:

- Support the Oregon Conservation Strategy's six state-wide actions to prevent new introductions, and decrease the scale and spread of infestations
- Implement and enforce ballast water management regulations

Since 2002, the Department of Environmental Quality has had authority under the Oregon Legislature to implement and enforce ballast water management regulations in an effort to reduce the risk of introducing new aquatic invasive species.

Enhancing Watershed Restoration & Fish Protections

Oregonians can be proud of the work that has been done to protect and restore watersheds throughout the state. Tens of thousands of stream miles have been restored through riparian habitat projects, removal of fish passage barriers, and restoring streamflows. All of these efforts have helped improve the ecological and economic health of Oregon's communities. Oregon's cooperative, community-level approach to watershed restoration, through the Oregon Plan for Salmon and Watersheds and the creation of locally-formed watershed councils, has significantly improved water quality and fish habitat. Oregon should build upon this good work to further enhance watershed restoration and fish protection efforts.

Fish Passage and Screening

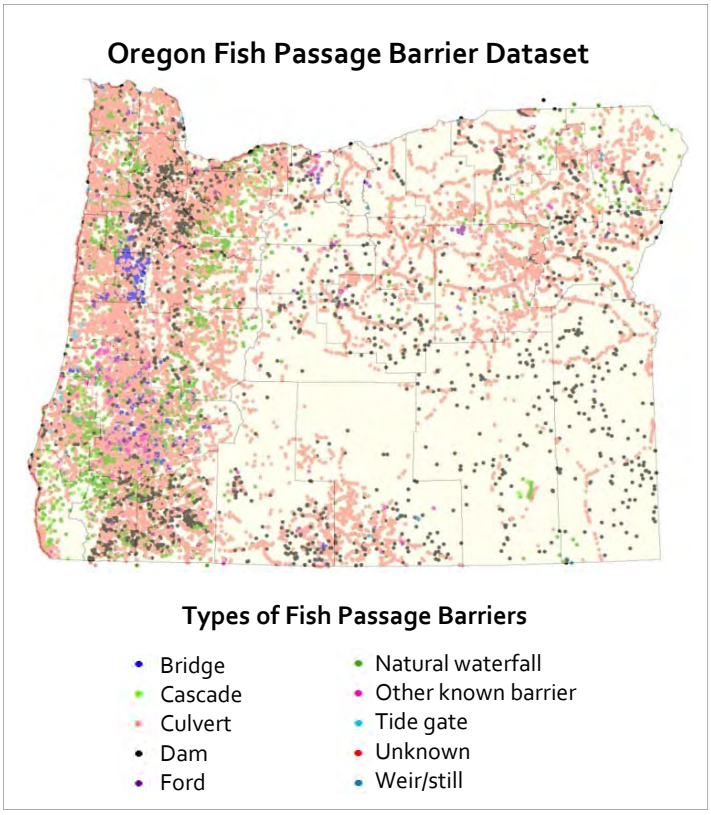
Before Oregon was officially recognized as a state, natural resource managers were concerned with providing stream passage for migratory fish. Barriers such as dams, dikes, road fill, and culverts change hydrological conditions and alter natural flow regimes. Many of these artificial obstructions create a drastic change in water surface elevation from one side of the structure to the other. Misaligned or improperly sized culverts can prevent fish passage, alter transport of sediment and wood, and create an uneven distribution of habitat.

The Oregon Department of Fish and Wildlife works with owners or operators in several ways to address barriers to fish passage. Recognizing the unique nature of migratory fish in the Pacific Northwest, many other agencies and organizations are also working on addressing fish passage barriers. Just recently, the Oregon Department of Fish and Wildlife worked with several partners at the local, state and federal level to compile data on fish passage barriers throughout the state.

Compiling this data is a first step in a long-term process to fill existing data gaps related to fish passage and fish habitat distribution, with the hope of integrating the two datasets to further fish passage restoration opportunities.

This initial effort resulted in the identification of more than 30,700 barriers to fish passage, which includes both natural (waterfalls, steep gradients, etc.) and artificial obstructions (dams, bridges, culverts, etc.). More than 75 percent of the barriers that were compiled are culverts.

Some of the barriers identified are passable, others are partially blocking or completely blocking passage, and for a large percentage—43 percent—it is unknown whether these barriers are passable or not.



Although significant progress has been made to compile data on fish passage barriers and fish habitat distribution, more work is needed. Data gaps in the coverage still exist, and several local, county, and federal agency inventories still need to be incorporated into the compilation.

Fish Screening: Another aspect of fish protection is fish screening, an important part of the Oregon Plan's efforts for the protection, restoration, and recovery of native migratory fish, such as salmon and steelhead. Fish screening can significantly reduce juvenile fish mortality at water diversions by preventing fish from entering diversion ditches, machinery, or irrigated fields. The Oregon Department of Fish and Wildlife operates the state's fish screening program and has helped install more than 1,400 fish screens through its cost-share program. Since the early 1990's, the State has required fish passage, bypass devices, or fish screening as a condition of approval for surface water permits and transfers.

The State should continue to support fish passage and screening efforts. This can be done through using funds from Oregon's Fish Screening and Passage Cost Sharing Program, and working with other state and federal funding partners. Replacing culverts with bridges, installing larger culverts, constructing fishways, stabilizing road fill material, and retiring obsolete and push-up dams are all techniques employed in Oregon today and should continue to be encouraged.

The Oregon Plan for Salmon and Watersheds

The Oregon Plan for Salmon and Watersheds (the "Oregon Plan"), mentioned earlier, is a statewide initiative launched in 1997 to help restore healthy watersheds that support the economy and the quality of life in Oregon. The Oregon Plan has a strong focus on salmon, largely because of the significant cultural, economic, and recreational importance to Oregonians—and because they are important indicators of watershed health. The Oregon Plan organizes specific actions—called "measures"—around factors that contribute to the decline in fish populations and watershed health. Many of these measures focus on voluntary actions to improve water quality and quantity and restore habitat. The voluntary actions and willingness of private citizens to implement restoration projects has been and will continue to be fundamental to the success of the Oregon Plan for Salmon and Watersheds.

Landowners and other private citizens, community organizations, interest groups, and all levels of government come together to organize, fund, and implement these measures in a coordinated manner. Oregon's watershed councils and soil and water conservation districts (SWCD's) assist landowners with projects and lead restoration efforts in many watersheds throughout the state. The Oregon Plan has bolstered interagency and state-federal coordination and collaboration. In 2002, for example, the Oregon Water Resources Department and the Oregon Department of Fish and Wildlife completed a joint project that identifies priority areas for streamflow restoration in basins throughout the state. These priority

areas represent watersheds in which there is a combination of need and opportunity for flow restoration to support fish recovery efforts under the Oregon Plan for Salmon and Watersheds.

Along with the Oregon Watershed Enhancement Board, several state agencies, federal agencies and non-profit organizations provide financial assistance for these restoration projects. The USDA Natural Resources Conservation Service, National Fish and Wildlife Foundation, the Oregon Departments of Fish and Wildlife and Environmental Quality, the U.S. Environmental Protection Agency, the U.S. Forest Service, and the U.S. Fish and Wildlife Service are actively funding watershed restoration projects throughout the state. As part of its responsibilities, the Bonneville Power Administration funds regional efforts to protect and enhance fish and wildlife populations affected by federal dams in the Columbia River Basin.

Les Perkins,
Farmers Conservation Alliance

The Farmers Screen

There are an estimated 76,000 surface water diversions in Oregon, supplying water for irrigation, municipal water supplies, power generation, and other uses. Fish screens are devices placed at diversions to prevent the fish, organic debris, and sediment that are naturally carried along in a river system from entering the diversion. When a diversion is unscreened or improperly screened, it can cause problems for fish populations and the water user alike. With the great diversity of terrain and hydraulic conditions at all of Oregon's water diversions, a full portfolio of screening technologies is needed to ensure an optimal match for each site.

15 cfs modular Farmers Screen near Parkdale, OR

160 cfs dual Farmers Screen near Sisters, OR

In an effort to reduce their operation and maintenance costs, protect fish, and keep their canals free of debris, Farmers Irrigation District (FID) in Hood River spent ten years developing a new kind of horizontal, flat-plate fish screen now known as the Farmers Screen. FID licensed the Farmers Screen technology to the non-profit social enterprise Farmers Conservation Alliance (FCA), also based in Hood River, so that revenue from sales of the technology could be invested into other solutions that benefit both fish and farms.

The Farmers Screen is unique in that it has no moving parts and no power requirement and is substantially self-cleaning. After years of biological testing proving the technology is safe for fish at all life stages, and several demonstration projects proving cost-saving benefits to farmers throughout Oregon, the Farmers Screen received federal approval in 2011 from the National Marine Fisheries Service.

As of June 2012, Farmers Screen installations in Oregon, Idaho, Wyoming, and Montana have converted a total of 484.2 cubic feet per second of diverted water to fish-friendly status, opening 167.7 river miles for safe fish passage while saving landowners a total of $493,700 annually in avoided operation and maintenance costs.

The Oregon Conservation Strategy

The Oregon Conservation Strategy, touched upon earlier in the invasive species discussion, was developed in 2006. It is broader in scope than the Oregon Plan and provides a blueprint and action plan for the long-term conservation of Oregon's native fish and wildlife and their habitats. It takes a non-regulatory, statewide approach to conservation. It also recognizes that conservation issues vary by region and requires conservation actions be tailored to the unique needs of the fish, wildlife and human communities that coexist throughout Oregon. The Oregon Conservation Strategy engages citizens in monitoring key species and attributes of ecosystems, and by measuring the effectiveness of conservation actions.

Future conservation efforts should be enhanced by continuing to implement and build upon the successful collaborative efforts of the Oregon Plan for Salmon and Watersheds, the Oregon Conservation Strategy, Northwest Power and Conservation Council's Strategy for Salmon, Conservation and Recovery Plans and Biological Opinions, and water quality implementation plans. The Integrated Water Resources Strategy should be used to strengthen and forge new partnerships.

Recommended Action 11.D
Protect and Restore Instream Habitat and Habitat Access for Fish and Wildlife

How to implement this action:

- Remove fish passage barriers and support fish screening efforts by implementing actions in Oregon's Conservation Strategy
- Build upon existing ecological planning and restoration efforts

Chris Park and Trish Carroll, U.S. Forest Service

Restoration after Mining: Many Hands Reclaim Sucker Creek, Josephine County

In 2011, the Siskiyou National Forest and its partners completed Phase II of the Sucker Creek Channel and Floodplain Restoration project. The project focused on a half-mile section of Sucker Creek that had been heavily altered by previous gravel mining on both private and U.S. Forest Service managed lands in Josephine County. Past mining activities had affected habitat, introducing higher temperatures and sediment and affecting coho and Chinook salmon, steelhead, and other native fish.

Pre-Project: Road and mine tailing

Post-Project: Downstream view immediately after channel construction

A variety of partners (The Forest Service, Oregon Watershed Enhancement Board, Ecotrust/Whole Watershed Restoration Initiative, Oregon Department of Environmental Quality, landowner Carlon Gravel Pit, LLC, and Illinois Valley Watershed Council) pitched in with grants, technical expertise and other support.

Partners constructed a new mainstem channel through mine tailings to create the pattern, dimension, and profile appropriate to the stream and valley type. They also placed large wood complexes in the channel and added floodplain and spawning gravels and boulders; planted native trees and shrubs; restored floodplain connectivity; and constructed habitat features including pools, riffles, runs, and glides. The long-term anticipated outcome of this project includes increasing the quantity and quality of habitat.

Already, successes are evident (see photo insert). This project won awards for mining reclamation in 2011.


Wallowa Lake, Wallowa County


Willamette River near Buena Vista, Polk County


Bandon Beach, Coos County

Photos: Gary Halvorson, Oregon State Archives

Oregon has a collective responsibility for protecting and managing water resources to ensure the health of its citizens. Part of this responsibility is ensuring that every citizen is treated fairly—regardless of race, culture, or income during the development of environmental laws, regulations, and policies. Oregon's natural resource agencies are committed to the principles of environmental justice—where equal protection from environmental and health hazards exists, and there is meaningful public participation in decisions that affect the environment in which people live, work, learn, practice spirituality, and play. In Oregon, adhering to the principles of environmental justice means that all persons affected by the state's natural resource decisions have a voice in those decisions, particularly members of minority or low income communities, tribal communities, and those traditionally under-represented in public processes.

The tools we use to protect public health, within the context of water management, are shared among many entities. The Oregon Health Authority and water system operators throughout the state are instrumental in making sure the water that enters our homes is safe for consumption and use. Other agencies, such at the Department of Environmental Quality, are working with partners to reduce toxics in the environment, clean up contaminated or hazardous sites, and ensure that the fish we consume are safe for *all* Oregonians. The Oregon Health Authority and the Oregon Department of Agriculture issue advisories when it is unsafe for recreational water activities at Oregon's beaches and lakes, or when fish and shellfish consumed from various Oregon's waters should be limited. Both agencies work with several other state, federal, and municipal agencies to keep the public informed.

Drinking Water

On average, a person will consume more than a quart of water each day. Some drinking water contaminants, such as bacteria, can cause acute health effects that generally occur within a few hours or days. Prolonged exposure of chemical contaminants, such as lead or arsenic, can cause cancer or organ damage. Drinking water is vulnerable to contamination from many potential threats. The Safe Drinking Water Act and its provisions are critical for protecting public health and drinking water.

Oregon should increase efforts to consult with and educate public water suppliers on safe drinking water regulations, contaminant standards, source water treatment options, and best practices to help prevent drinking water contamination. In particular, efforts should be expanded to support Oregon's smaller public water systems.

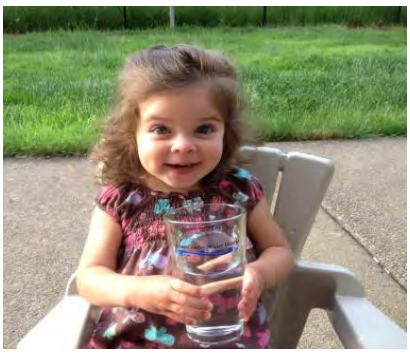


Photo: F. Reed, Tualatin Valley Water District

Municipal water providers in Oregon deliver safe drinking water to approximately 88 percent of the state's population.

Source Water Assessments

From 1998 to 2006, the Oregon Health Authority and the Department of Environmental Quality completed source water assessments for more than 2,400 public water systems in Oregon. The assessments include a delineation of the geographic area that supplies the public water system and information on potential contamination risks, natural and human-caused. This information is a valuable tool for safeguarding drinking water protection areas.

Land Use Planning Goal 5 requires communities to protect these drinking water sources, once they have been identified as resources. State and local governments should further collaborate on drinking water source pollution prevention efforts. Protection efforts should be enhanced by providing federal Safe Drinking Water Act revolving loan funds for source water protection projects.

Contaminants of Emerging Concern

Some chemicals that previously had not been detected are now being detected. These are often generally referred to as "contaminants of emerging concern" (CECs) because the risk to human health and the environment associated with their presence, frequency of occurrence, or source may not be known. State and federal agencies are working to improve the understanding of a number of CECs, particularly pharmaceuticals, personal care products, and perfluorinated compounds, among others.

Oregon should consider increased monitoring of public drinking water for contaminants of emerging concern. Monitoring can determine occurrence/concentration of contaminants, and if or how such contaminants pose individual, cumulative, or synergistic health risks to the public. These data could be used in conjunction with U.S. EPA's Unregulated Contaminant Monitoring Rule data to evaluate connections among source sensitivity, potential contaminant sources in the area, and overall system vulnerability to contamination. Monitoring would also provide better information on the public health impacts of these contaminants in Oregon.

Drinking Water Emergencies

Oregon's statewide emergency response system should be designed to quickly respond to drinking water emergencies. All water providers should be encouraged to join the Oregon Water/Wastewater Agency Response Network, a statewide mutual aid agreement specific to water and wastewater agencies that provides access to equipment and personnel. Drinking water providers should also partner with other regional networks and organizations. The Regional Disaster Preparedness Organization (UASI Region), and the Regional Water Providers Consortium in the Portland Metro area are two such networks that can help with development of regional emergency preparedness, response and recovery, and coordination of resources.

Water Quality & Domestic Wells

The Safe Drinking Water Act covers public water systems; however, it does not regulate private wells providing water for fewer than 25 individuals. In rural areas, private wells are often used as a source for water. In fact, more than 90 percent of people living in rural areas rely on groundwater from such wells to meet their drinking water needs.

Recommended Action 12.A
Ensure the Safety of Oregon's Drinking Water

How to implement this action:

- Assist public water suppliers; support small public water systems
- Protect drinking water sources
- Monitor public drinking water for contaminants of emerging concern
- Encourage water providers to join the Oregon Water/Wastewater Agency Response Network
- Increase domestic well testing

In Oregon, the owner of a property with a private well must test for nitrate, coliform, and arsenic if the property is being sold or changing ownership. California, Colorado, Georgia, Idaho, Indiana, Oregon,

Pennsylvania, Washington, and Wisconsin have been identified as having the highest nitrate concentrations in shallow groundwater in the United States. Of these states, only Oregon has enacted legislation that requires private well testing at the point of a real estate transaction.

While Oregon's Domestic Well Testing Act requires collection of nitrate, coliform, and arsenic data during the sale of a property, there is currently no authority to enforce the requirement. Public health officials estimate a 10 to 20 percent compliance rate. Mechanisms to increase domestic well testing are needed, along with resources to help educate and train homeowners on water quality testing of private wells (see also Recommended Action 8.C., Promote Community Education and Training Opportunities).

Toxics and Other Pollutants

Protecting Oregonians from the impacts of toxic pollutants is one of the top priorities for the Oregon Department of Environmental Quality. Thousands of toxic chemicals are in products that individuals and businesses use daily. Old chemicals that may not be used today but are stored in homes, schools and businesses also pose risks. Whether used in their raw form or in products, these chemicals can be released into Oregon's air, water and land as toxic pollutants in a variety of ways. Once in the environment, toxic pollutants can adversely affect the health of people and other living organisms.

Toxics Reduction Strategy

The Oregon Department of Environmental Quality is developing a toxics reduction strategy that will identify reduction options that address a range of toxic pollutants that move among air, land, and water. DEQ's strategy will increase the efficiency of reduction efforts while ensuring Oregon addresses the problem comprehensively. It will place an emphasis on reducing toxic pollutants at the source, rather than managing them after they are released.

Oregon DEQ completed a draft of its Toxics Reduction Strategy in December 2011 and hopes to finalize it by Fall 2012. In addition, Executive Order No. 12-05 ("Environmentally Friendly Purchasing and Product Design") signed by Governor Kitzhaber in April of 2012 provides additional support for DEQ's Toxics Reduction Strategy by focusing the work of other state agencies on achieving toxics reduction goals. In addition, the Executive Order will result in Oregon's state agencies and universities having a set of guidelines for purchasing and using less toxic chemicals within building materials, electronics, cleaning products and other items. Making the implementation of DEQ's Toxics Reduction Strategy and the Executive Order a priority will also allow agencies, businesses and academic institutions to advance green chemistry efforts, and promote alternatives to priority toxic chemicals that reduce environmental and health impacts in addition to producing potential economic benefits.

Water Quality Pesticide Management Plan

An important task for managing toxics is to implement the statewide Water Quality Pesticide Management Plan. Led by the Oregon Department of Agriculture, a team composed of representatives from the Oregon Department of Forestry, Oregon Department of Environmental Quality, Oregon Health Authority, and Oregon State University implements this plan, which calls for coordination of agency and stakeholder activities to:

- select and prioritize pesticides of interest and pesticides of concern;
- establish water quality guidelines and reference points;
- watershed vulnerability assessments;
- design, conduct, and guide monitoring efforts (including the Pesticide Stewardship Partnership Program monitoring);
- recommend and facilitate management options; and
- develop communication strategies.

Oregon should commit to implementing the Pesticide Management Plan to make water quality programs across the state more consistent and resource efficient.

Pesticide Stewardship Partnerships

Since 2000, Oregon DEQ has used a voluntary, collaborative approach called Pesticide Stewardship Partnerships (PSPs) to identify problems and improve water quality associated with pesticide use at the local level. DEQ partners with OSU Extension, soil and water conservation districts, watershed councils, grower groups, tribes, and the Oregon Departments of Agriculture and Forestry. The PSPs are funded largely through federal grants and use local expertise in combination with water quality sampling and toxicology expertise of DEQ to encourage and support voluntary changes that result in measurable environmental improvements. The Water Quality Pesticide Management Team helps guide these local partnerships and assists in the interpretation of the monitoring data.

Currently there are eight partnerships in seven watershed areas. The eight include Hood River; Mill Creek and Fifteenmile Creek (in Wasco County); the Walla Walla River; Clackamas River; Pudding River; Yamhill River (Yamhill Pesticide Stewardship Partnership for rural and urban areas, and South Yamhill River Pesticide Stewardship Partnership, for a forested area of the watershed); and the Amazon Creek watershed project in Eugene.

The first partnerships implemented (Hood River and Mill Creek Basins) have shown substantial improvements in water quality associated with changes in pesticide management practices in response to monitoring data. The Hood River and Mill Creek successes show the Pesticide Stewardship Partnership approach could be an effective, timely alternative to traditional regulatory approaches dealing with "non point" sources of chemicals in water. Oregon should continue supporting the collaborative efforts of Pesticide Stewardship Partnerships.

Photo: Marion County Soil & Water Conservation District

Spray equipment demonstration at pesticide drift reduction workshop, Pudding River Watershed.

Hazardous Waste Collection – Pesticides & Medications

Keeping pollutants out of the water, rather than treating it later, is certainly the easiest way to protect water quality. Proper disposal of unused or outdated chemicals can help prevent pollutants from entering Oregon's waterways. For example, pesticides that are stored in deteriorating containers may lead to spills or leaks with potentially significant impacts to surface water and groundwater.

Legacy pesticide collection events around Oregon provide an opportunity to bring pesticides that are no longer used to a central location to properly dispose of them for free or at a reduced charge. These collection events help to remove old or unusable pesticides that pose a direct threat to Oregon's water quality. Since 2006, nearly 209,500 pounds of pesticides have been collected from agriculture pesticide collection events, in coordination with Pesticide Stewardship Partnership projects and other collaborative water quality improvement programs. Three counties—Hood, Sherman, and Wasco County—operate permanent hazardous waste collection facilities, offering free agriculture pesticide collection for local farmers and ranchers.

Like pesticides, unused medications can pose problems for Oregon's water resources. Often times, unused or expired medications are disposed of by flushing down drains in homes, care facilities, medical clinics, doctors' offices, and hospitals. In one recent national study, scientists analyzed streams for 95 different organic wastewater contaminants, including pharmaceutical compounds. One or more of these wastewater contaminants appeared in 80 percent of the streams. Risks posed to aquatic organisms by long-term exposure to various pharmaceutical compounds are unknown.

Wastewater treatment plants and septic systems usually do not treat or only partially treat pharmaceuticals, allowing certain chemical compounds to reach surface water or groundwater resources. Drugs of concern include controlled and non-controlled prescription drugs, as well as over-the-counter medications. Proper management of these drugs reduces avoidable poisoning of both children and adults; prevents intentional misuse of unwanted prescription drugs, especially by teenagers; and protects water quality and fish.

Oregon should continue to establish and fund "take back programs" for unused and outdated chemicals. These include pharmaceutical take-back programs for communities, pesticide collection events for farmers, ranchers, and homeowners, and other hazardous waste collection events or facilities.

Contaminated or Hazardous Sites

Sites, facilities, or structures originating as industrial, military, transportation, energy or other uses may be in such condition that they pose a serious or imminent hazard of emitting or discharging substantial amounts of toxics or other pollutants to water resources. Oregon should continue identifying and addressing hazardous or contaminated sites and all immediate legal means and enforcement mechanisms should be employed to prevent such emissions or discharges before they occur. Continuing to provide technical and financial assistance to clean up existing contaminated sites that affect groundwater or surface water is also needed.

Addressing existing hazardous and contaminated sites is not only important for protecting environmental and public health, it can lead to future economic development opportunities for local communities. The redevelopment of brownfields—sites where future use may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant—is changing the way contaminated property is perceived and addressed. With an estimated 450,000 brownfields in the United States today, there are many opportunities to make contaminated properties economically viable for a variety of purposes and uses.

Recommended Action 12.B
Reduce the Use of and Exposure to Toxics and Other Pollutants

How to implement this action:

- Finalize and implement DEQ's Toxics Reduction Strategy
- Implement green chemistry executive order, including revising purchasing practices related to toxic chemicals
- Implement Water Quality Pesticide Management Plan
- Support Pesticide Stewardship Partnerships
- Establish and fund "take back programs"
- Continue to identify and address hazardous or contaminated sites, including brownfields
- Prevent blue-green algae from forming beyond natural background levels
- Monitor recreational waters and inform the public when contaminants are present

In Oregon, brownfields have been cleaned up and revitalized into an urban community garden, additional facilities for a Portland-area college, and a food bank operations center and thrift store in a rural Oregon community. Although these are just a few examples, the economic opportunities are many for brownfields redevelopment. Assessing current exposures, preventing future exposures to contamination, and ensuring that environmental justice and community health concerns are integrated throughout the redevelopment and reuse planning process is an important component of brownfields redevelopment. Oregon should continue to focus efforts on addressing hazardous and contaminated sites, while looking at opportunities to further economic development.

Monitoring Recreational Waters and Informing the Public

When locally caught fish and shellfish accumulate toxic chemicals because of spills or toxic algae blooms they pose health risks to those who consume them. The Oregon Department of Environmental Quality establishes the level of protection needed to ensure public health, by setting water quality standards and

establishing fish consumption rates that are safe for humans. DEQ recently worked with tribes, agency partners, and other stakeholders to revise the fish consumption rate and Oregon's water quality standards. These standards represent the most stringent human health criteria in the nation.

With millions of people participating in recreational activities each year, whether to harvest shellfish, catch local fish, swim or boat at a favorite lake, or play along Oregon's coastline, it is important to notify the public with any health or safety concerns. State agencies use a variety of approaches and tools to protect people living, working and playing near Oregon's beaches, rivers, lakes, and other water bodies.

Issuing fish and shellfish consumption advisories is one such tool used by Oregon's natural resource agencies. The Oregon Health Authority issues fish consumption advisories, due primarily to moderate-to-high mercury levels or PCB's (polychlorinated biphenyls) found in locally caught fish. Today, there are 19 different water bodies where fish consumption advisories exist.

The Oregon Department of Agriculture and the Oregon Department of Fish and Wildlife jointly issue shellfish safety closures to protect recreational shellfish harvesters from consuming clams or mussels contaminated with harmful biotoxins. Shellfish can be contaminated by natural events such as harmful algae blooms or man-made events such as sewage spills. The presence of marine biotoxins is the most common reason for shellfish closures in Oregon's coastal waters. Biotoxins can cause mild to severe health problems for consumers. The Oregon Department of Agriculture also maintains an online site with biotoxin results, recent news releases, and encourages the public to call the shellfish safety hotline before harvesting.

Oregon Harmful Algae Bloom Surveillance Program: Public health and safety concerns associated with recreational use of lakes and other waters have been growing over the past several years. When toxic algae blooms are detected in the water, the Oregon Harmful Algae Bloom Surveillance program advises the public to avoid recreational contact with water, such as swimming, wading, or water-skiing.

Advisories are only issued for lakes, reservoirs, and rivers where a lab has verified the presence of a harmful algae bloom. Only a fraction of Oregon's many water bodies are monitored. In 2010, twenty-two algae-related health advisories were issued throughout Oregon, as compared to 6 in 2005. Advisories were in effect for 272 days compared to 193 days in 2009. The increase could indicate that cyanobacteria blooms are increasing in severity, but may also reflect enhanced surveillance efforts among local, state, and federal partners.

Key actions include preventing blue-green algae from forming in lakes, streams and ponds beyond natural background levels. Blue-green algae, or cyanobacteria, can irritate skin, cause liver malfunction, or affect the nervous system. They thrive in warm, stagnant waters that have significant concentrations of nutrients, particularly phosphorus. Steps should be taken to control phosphorous from entering the water body through fertilizer runoff, septic systems, and other sources. Additional prevention techniques include increasing water flow through the lake or reservoir, artificial circulation of water within the reservoir, and improved watershed management.

The Oregon Beach Monitoring Program: This program monitors recreational water quality at ocean beaches. Marine waters are tested for the bacterium enterococcus, which is an indicator of the presence of other illness-causing organisms. Enterococcus has been shown to have a greater correlation with swimming-associated illnesses than other bacterial organisms. Enterococcus is present in human and animal waste and can enter marine waters from a variety of sources such as streams and creeks, stormwater runoff, animal and seabird waste, failing septic systems, sewage treatment plant spills, or boating waste. When bacteria levels are above normal, a water contact advisory is issued.

The goal of the program is to protect public health by providing information about water quality, strengthening water quality standards at beaches, and promoting scientific research. The public can sign up for email alerts to receive notices when advisories have been issued at certain beaches.

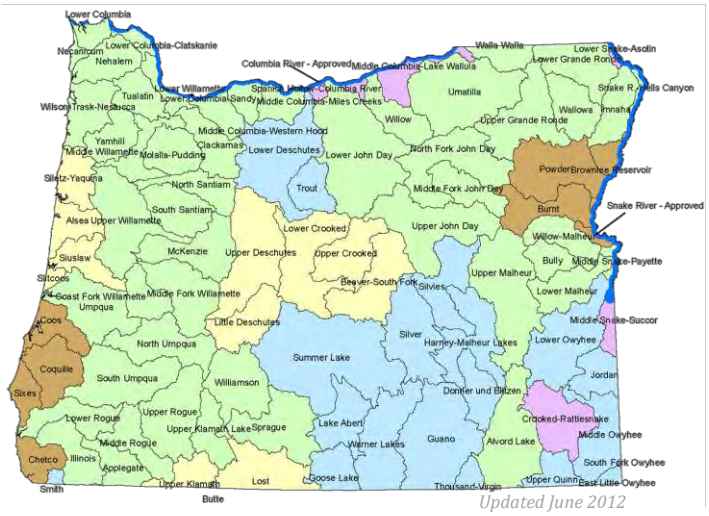
While the Beach Act currently provides funding from the U.S. Environmental Protection Agency to monitor ocean beaches for fecal contamination and the National Oceanic and Atmospheric Administration currently provides funding to monitor the coast and recreational shellfish for cyanobacteria, given the current federal budget environment, these and similar programs are at risk of being eliminated.

Additionally, there is no ongoing funding commitment at any level to monitor *freshwater* recreational areas and inform the public regarding exposures. Oregon needs to continue monitoring recreational waters at its beaches, and within its rivers and lakes, in order to be able to inform the public when contaminants are present.

Implementing Water Quality Pollution Control Plans

Oregon's long history of assessing and reporting on the conditions of Oregon's waters began in 1938 when the Oregon State Sanitory Authority (now the Oregon Department of Environmental Quality) was established as a result of a citizen initiative.

Today, Oregon's Total Maximum Daily Load (TMDL) Program is an important tool for managing water quality. A TMDL describes the maximum amount of pollutants allowed from municipal, industrial, commercial, and surface runoff sources, including natural background that can enter waterways without violating clean water standards. The Oregon Department of Environmental Quality recently completed 1,153 TMDLs in Oregon (see accompanying map).



Updated June 2012

TMDL Development Status for 303(d) Listed Waters

- EPA Approved
- TMDL Report In-Progress (Data analysis & reporting writing phases)
- TMDL Initiated (Initial scoping & data collection phase)
- TMDL Not Started (Minimal or no activity)
- No TMDL Necessary (No 303(d) listings)

It is important to continue developing and implementing Total Maximum Daily Load plans for water bodies that do not meet water quality standards. This includes developing TMDLs for remaining water bodies and pollutants on Oregon's 303(d) list and for those added in the future, in accordance with the federal Clean Water Act. It also includes reviewing and updating existing TMDLs and providing oversight to ensure that TMDL implementation measures are effective.

Nonpoint Sources of Pollution

A nonpoint source (NPS) of pollution is any pollution entering a waterbody that does not come directly from a pipe. Nonpoint source pollution, unlike end-of-pipe pollution from industrial and sewage treatment plants, comes from many diffuse sources, including runoff from agricultural, forest and ranching activities, construction sites, home landscaping and road surfaces.

Oregon's NPS Program is an important part of the state's water pollution control programs because for some pollutants, nonpoint sources of pollution are the major sources of pollution to a waterbody. In 2010, Oregon awarded more than $1.38 million in Section 319 grants to 33 projects to address nonpoint source pollution. Funding through 319 grants is used to implement best management practices, to support TMDL implementation plans and Pesticide Stewardship Partnerships throughout the state, and for educational or informational outreach efforts.

Oregon will need to continue assisting landowners with the management of non-point source pollution across all land uses (e.g., urban, agriculture, forestry) to ensure the protection of surface water and groundwater. This can be done by building upon the Forest Practices Act and local Agricultural Water Quality Management Plans to ensure compliance with water quality standards and TMDL load allocations. Oregon should increase monitoring to ensure the efficacy of forestry and agricultural best management practices.

Stormwater in Urban Areas

As discussed earlier, within the context of land use and low impact development techniques, stormwater runoff often contains pollutants that can adversely affect water quality. National Pollutant Discharge Elimination System (NPDES) permits are required for stormwater discharges to surface waters from construction for industrial activities and municipalities if stormwater from rain or snow melt leaves the site through a "point source" and reaches surface waters either directly or through storm drainage.

Recommended Action 12.C
Implement Water Quality Pollution Control Plans

How to implement this action:

- Continue to develop and implement TMDLs for water bodies that do not meet water quality standards
- Continue to address nonpoint sources of pollution across all land uses; increase monitoring
- Ensure effective management and oversight of stormwater in urbanized areas
- Assist communities with septic system challenges

A municipal separate storm sewer system, or "MS4", is a conveyance or system of conveyances (e.g., roads with drainage systems, municipal streets, catch basins, curbs, gutters, manmade channels or storm drains) owned or operated by a governmental entity that discharges to waters of the State. Sources that need to obtain an NPDES MS4 permit are classified as either "Phase I" or "Phase II." Phase I NPDES MS4s are those with populations greater than 100,000, while regulated Phase II (or "small") MS4s serve populations less than 100,000 located within Census Bureau-defined Urbanized Areas. Federal regulations also provide EPA and the states the discretion to require other MS4s outside of urbanized areas to apply for a permit.

Oregon needs to ensure the effective management and oversight of stormwater in urbanized areas through the implementation of NPDES MS4 permits, TMDL Implementation Plans for Urban Designated Management Agencies, or through comparable voluntary plans.

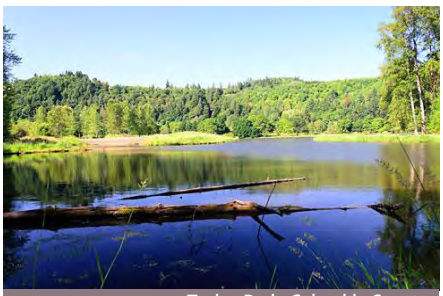
Septic Systems in Rural Areas

State law provides the Oregon Department of Environmental Quality with regulatory authority over on-site sewage treatment and disposal. More than one million Oregonians, or about 35 percent of the state's population, use on-site sewage systems, also known as septic systems. Most of these are single-family homes in rural areas without access to community sewer systems.

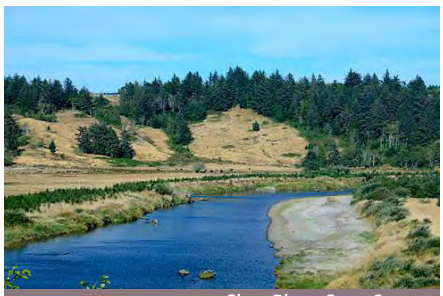
A failing septic system increases the risk of contamination of both surface water and groundwater and can be a public health hazard. Septic systems are required to be inspected at the time of construction to ensure they are correctly installed and functioning properly. Businesses that install septic systems or provide pumping services are regulated through a statewide licensing program. DEQ provides direct service for on-site system permitting and installation in 14 counties around the state. These include

Clatsop, Coos, Douglas, Josephine, Baker, Grant, Gilliam, Harney, Lake, Morrow, Umatilla, Union, Wallowa, and Wheeler counties. The 22 remaining Oregon counties manage the program through local governments under contract and oversight from the state. Oregon should continue to provide technical and funding assistance to landowners who need to replace or repair failing septic systems. Similar assistance should be provided to communities needing to address public health or water quality problems associated with individual subsurface sewage disposal systems.

CRITICAL ISSUE: FUNDING FOR OREGON'S WATER


Trojan Park, Columbia County


Waldo Lake, Lane County


Sixes River, Curry County

Photos: Gary Halvorson, Oregon State Archives

The Strategy lays out an extensive blueprint of actions that the State and its partners can undertake to better understand and meet instream and out-of-stream needs now and into the future. Implementing every action in its entirety would be cost prohibitive in today's economy. It is instructive to learn about how other states have approached funding these types of actions and work in recent years. Many other western states have invested heavily in water-related planning, operations, and projects, even in dire economic times.

This section lays out funding needs in three fundamental categories: implementing Oregon's Integrated Water Resources Strategy at the state and local level, managing water resources at the state level, and assisting with local water projects.

Funding an Integrated Water Resources Strategy

Limited funding was available to develop the state's Integrated Water Resources Strategy in 2009-11 and again in 2011-13. Two limited duration positions were used to convene and manage the public process, oversee the scientific and technical work products, and develop and produce the content of the Strategy.

Recommended Action 13.A
Fund Development and Implementation of Oregon's Integrated Water Resources Strategy

How to implement this action:

- Fund implementation of 2012-2017 IWRS
- Fund required updates of state-level IWRS
- Fund development of place-based IWRS

The Water Resources Department is required to update the Strategy every five years. This allows the State to evaluate whether we are achieving our goals of improving our understanding of Oregon's water resources, and meeting our instream and out-of-stream water needs. Implementation also includes development of further project details for legislative action, fulfillment of scientific, outreach, and policy obligations, and documentation of lessons learned.

The goals, objectives, and recommended actions spelled out in the Integrated Water Resources Strategy will be meaningless without dedicated funding. Implementation begins in Fall 2012 and coordination among state, local, federal, and private partners will be needed.

In the coming years, an effective state-wide Strategy will require efforts at the local level as well, to develop place-based strategies that can guide not one, but a series of projects over time. Funding should be available to help communities conduct place-based planning and sustain the type of effort and expertise required to establish and implement the integrated strategies that emerge.

Investment in Planning Efforts - What Other States are Doing

Several western states, including Washington, California, Colorado, New Mexico, Oklahoma, and Texas, have taken on a formal approach to locally-led planning, with direction and financial investments coming primarily through state resources. In each of these cases, regional or basin councils are formally delineated, with staff and budget assigned, formal stakeholder positions filled, and workplan and reporting requirements in place. These regional plans then roll up and inform state-level plans, which have traditionally been focused on water supply issues, but increasingly, plans are being broadened to encompass water quality, ecosystem needs, and the risks related to climate change.

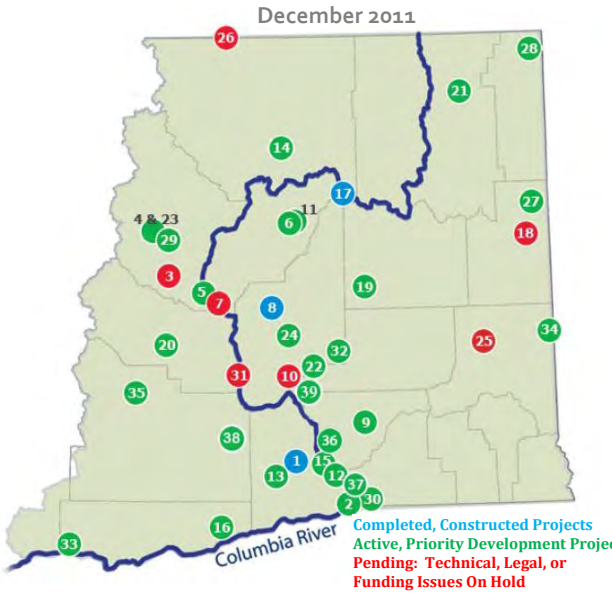
Other states that conduct statewide, long-term, water planning have invested considerably in staff and consultants to conduct this work as well. For example, Georgia had a one-time budget in 2009-11 of $36 million to conduct planning across 10 regions; Texas had a $3 million budget in 2009-11 for planning across 16 regions; and Wyoming has about $500,000 per year to conduct planning across seven basins.

Oregon's neighbors to the north and south have also made significant investments. The State of California began developing long-term water plans 50 years ago, and is statutorily mandated to update them every five years. Although California has set aside a budget for these purposes, it has dwindled over time from $4.5 million in 2000 to $2.5 million in 2008, and even less today. About 40 part-time staff members work throughout the state on data collection and water budgeting, 15 more are located in district offices conducting data processing, and an additional 30 to 40 experts provide in-kind technical work.

In 2006, the State of Washington secured $200 million in general obligation bonds consistent with its legislative mandate to "aggressively pursue development of water supplies to benefit both instream and out-of-stream water uses." The Washington Legislature directed the Washington Department of Ecology to allocate two-thirds of the money to out-of-stream uses and one-third to augment instream flows.

To date, Washington has used these monies primarily to study the feasibility of water supply projects. The accompanying map shows almost 40 projects under consideration in the Columbia River Basin, using these monies.

Washington's
Office of Columbia River Funded Projects



For more information, visit: http://www.ecy.wa.gov/programs/wr/cwp/projects.html

Funding Water Management at the State Level

Natural resources are critical to Oregon's economy. Natural resource activities such as agriculture, forestry, fisheries, and mining, as well as recreational activities and tourism including fishing, hunting, viewing wildlife, camping, and hiking are major economic drivers in Oregon's economy.

Oregon's natural resource agencies compiled the following facts for 2011:

- The total combined economic activity of Oregon's natural resource industries exceeds $55 billion in output—37 percent of the state's annual domestic product.
- Approximately 550,000 Oregonians work in natural resource-related fields, or jobs supported by those industries, comprising more than one-third of the state's employment.
- For every $1 in General Fund invested in natural resource agencies, $376 in economic activity is generated by Oregon's natural resource sector.

The General Fund

Because General Fund monies are used for a variety of public purposes and the amount of General Fund is limited, there is intense competition for these monies. The General Fund is used most often to pay for education, human services, and public safety.

Since the 1999-2001 biennium, the average General Fund investment across all state agencies has risen 31.33 percent; however, the investment in natural resource agencies has declined 2.5 percent. In 2009-11, Oregon's General Fund investment in natural resource agencies equated to less than one percent, or $145 million, of Oregon's $13 billion General Fund budget. In the most recent budget (2011-13), that share has fallen even further, to $129 million, with six natural resource agencies not receiving any portion of the General Fund. This includes the state's drinking water program, which is responsible for providing oversight and assistance to public water systems to ensure safe drinking water and protect public health for Oregonians.

2011-13 General Fund (GF) Budget for Natural Resources Agencies

	GF (millions)	GF as % of Total Funds
Forestry	$ 47.9	16%
Environmental Quality	$ 24.9	8%
Water Resources	$ 20.6	56%
Agriculture	$ 12.8	15%
Land Conservation & Development	$ 10.9	60%
Fish and Wildlife	$ 7.1	2%
Geology and Mineral Industries	$ 2.5	19%
Land Use Board of Appeals	$ 1.3	94%
Columbia River Gorge Commission	$ 0.8	99%
State Lands	$ 0.0	0%
Energy	$ 0.0	0%
OHA, Drinking Water Program	$ 0.0	0%
Parks and Recreation	$ 0.0	0%
Watershed Enhancement Board	$ 0.0	0%
State Marine Board	$ 0.0	0%

Over the years, natural resource agencies have become more reliant on lottery funds and federal funds, which are often geared toward specific, local projects, rather than maintaining core functions and daily operations. Many natural resource agencies also rely on "fees for service;" however, these funds do not completely cover the real cost of conducting transactions and have suffered with the recent economic recession as well. These funding sources are also expected to decrease significantly in the coming years. Loss of funds at the state level creates a domino effect, where dollars removed from state agency budgets results in lost matching dollars at the federal level.

The state's core responsibilities related to water, described in detail throughout this document, are underfunded and have been for years. The trend of declining General Fund investment must be reversed in order to ensure Oregon's natural resource legacy for future generations and to implement our shared vision for the future. Natural resource agencies in Oregon are developing a number of ideas to stabilize their budgets from the steep decline in General Fund, and are watching other western states with interest, as they do the same.

Alternatives to the General Fund – Models from Other States

The State of California has been working for several years to establish a funding mechanism that relies less on the General Fund in order to pay for its day-to-day operations. In 2003, the California Legislature passed Senate Bill No. 1049, directing the California Water Resources Control Board's Water Rights Division to charge annual user fees to fund its operations.

Water permit and license holders are charged a fee of $100 or $0.03 per acre-foot of water, whichever is higher. This fee was designed to cover a budget of approximately $7 million. Although challenged in the courts by water users, the water right fee program was found to be "facially constitutional" by unanimous decision of the California Supreme Court in 2011, and is operating today.

In Minnesota, $75 million in dedicated funds is available each year under Minnesota's 2008 Land, Water and Legacy constitutional amendment. The amendment increased the general sales and use tax rate by three-eighths of one percentage point to 6.875 percent. One-third of the proceeds are dedicated to water quality protection, one-third to restoration of wetlands and other wildlife habitat, and the remaining third to support parks, arts, and cultural heritage efforts.

Here in Oregon, the Water Resources Commission appointed a subcommittee to work with staff in the development of funding options. After meeting with more than thirty stakeholder organizations, the subcommittee and staff generated a list of dozens of potential funding options, "to ensure the Department can fulfill its mission and legally mandated responsibilities successfully, in service to Oregon's economy and environment." The group evaluated these funding options against the following principles: (1) "user pays," (2) fees should be equitably distributed, (3) fees should be used toward the purpose for which they are collected, and (4) fee collection must be logistically reasonable. The subcommittee and staff continue to work with the Governor's Office and Legislature to analyze and finalize options for legislative consideration.

Recommended Action 13.B
Fund Water Resources Management Activities at the State Level

How to implement this action:

- Fund those water management activities for which the State has responsibility
- Ensure increased and adequate funding from the General Fund
- Seek additional funding sources

Funding Investments in Local Projects

Oregon's state agencies, several of its federal counterparts, and both commercial and investment banks have a variety of funding mechanisms available to pay for water resource projects, ranging from infrastructure finance, to feasibility study grants for water supply, conservation, and reuse projects, and grants for watershed protection and restoration activities.

Infrastructure Financing

The U.S. Environmental Protection Agency estimates Oregon's infrastructure needs at approximately $3 billion for municipal drinking water systems, based on its 2007 needs survey. Costs can include capital

construction and maintenance, transmission, storage, treatment, and distribution. These costs involve routine construction and maintenance, and do not include the billions of dollars worth of seismic retrofits and emergency preparedness efforts that Oregon needs to undertake in the next 20 years.

As previously mentioned in the infrastructure financing discussion (p. 70), Oregon communities have a number of opportunities to access infrastructure funding, from revolving loan funds, to state and federal grants, and the bond market. As one example, USDA Rural Development provides loans, grants, and loan guarantees for drinking water, sanitary sewer, solid waste and storm drainage facilities in rural areas and cities and towns of 10,000 or less. The Rural Community Assistance Corporation has a Wastewater Funding and Resource Guide containing additional state and federal funding sources.

The League of Oregon Cities, Association of Oregon Counties, and Special Districts Association of Oregon each have funding mechanisms for their members, which are accessible through their respective associations. Private financial institutions also underwrite bond financing and loans.

Funding for Feasibility Studies

Local communities often find it difficult to secure feasibility study funding as part of their project development. Such studies help determine the environmental, engineering, economic, and social implications of proposed water supply projects.

Recommended Action 13.C
Fund Communities Needing Feasibility Studies for Water Conservation, Storage, and Reuse Projects

How to implement this action:

- Continue to provide SB 1069 grants to help evaluate the feasibility of water conservation, storage, and reuse projects

One way Oregon can help with costs is to bridge the existing funding gap for feasibility studies. In 2008, the Water Resources Department awarded approximately $1.3 million in feasibility study grants to 21 Oregon communities, plus funds for the Umatilla Basin Aquifer Recovery Project. In 2011, the Oregon Legislature provided another $1.2 million for this grant program, which funded feasibility studies in more than 20 Oregon communities.

Funding for Watershed Restoration

Since 1999, the Oregon Watershed Enhancement Board has awarded 5,500 grants totaling $434 million to partners in Oregon. OWEB grants are funded from the Oregon Lottery, federal dollars, and salmon license plate revenue. This has resulted in more than 5,100 miles of stream restoration, including improved stream habitat and removal of fish passage barriers. In addition, more than 5,400 miles of stream banks have received riparian forest restoration, benefiting salmon and steelhead. Oregon consistently reports about the same length of stream mile restoration as Alaska, California, Idaho, Washington, and Pacific Northwest Tribes, combined.

Ninety percent of OWEB investments stay in Oregon. Restoration project managers typically hire local consultants, contractors, and employees to design, implement, and maintain projects. Consultants and contractors hire field crews, rent or purchase equipment, and buy goods and services. Employees spend wages on goods and services to support their livelihoods in their local communities. The payoffs of habitat restoration projects yield immediate jobs at a level very similar to traditional infrastructure investments.

Oregon's watersheds also benefit from significant annual investments by the Bonneville Power Administration. In fiscal year 2011, BPA spent about $56 million on fish and wildlife programs in Oregon. Under the Willamette Wildlife Agreement, BPA will provide $144 million over the next 15 years for habitat protection in the Willamette River Basin. These investments translate into an improvement in ecosystem conditions and enhancement of local economies.

Pooling Funding Sources

Navigating through different funding sources and requirements, while continuing to meet the objectives of the local community, can be a significant challenge for instream and out-of-stream projects. The Whole Watershed Restoration Initiative, described in the accompanying essay, was created to help project proponents make sense of the funding maze.

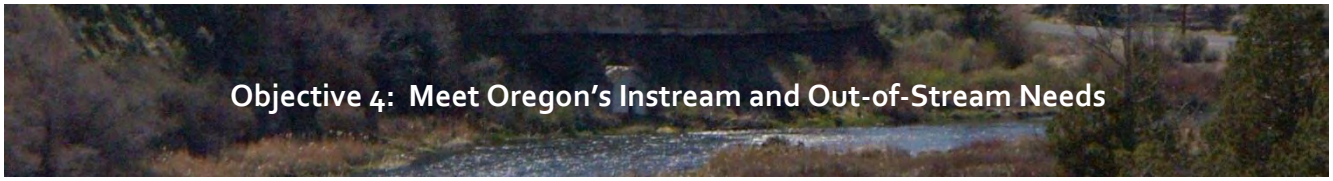
Cathy P. Kellon, Ecotrust

Public and Private Organizations Working together to Fund Watershed Restoration

The Whole Watershed Restoration Initiative (WWRI) is a competitive salmon habitat restoration grant program in Oregon, Washington and Idaho. The WWRI is a public-private partnership whereby state and federal agencies contribute restoration dollars to the Initiative and Ecotrust, a nonprofit, then makes these pooled funds available as grants to local groups for on-the-ground restoration work. The goal is to restore natural ecosystem processes for the benefit of salmon and communities. The approach is to fund work where there is strong community support, effective collaboration, and high ecological value to salmon.

The WWRI partnership was formed in 2007 and is comprised of Ecotrust, the Oregon Watershed Enhancement Board, the Pacific Northwest Region of the USDA Forest Service, the U.S. Fish and Wildlife Service, the National Oceanic Atmospheric Administration's Restoration Center, the Bureau of Land Management, and USDA's Natural Resource Conservation Service.

Recommended Actions at a Glance



Objective 4: Meet Oregon's Instream and Out-of-Stream Needs

Place-Based Efforts	9.A. Undertake place-based integrated, water resources planning 9.B. Coordinate implementation of existing natural resource plans 9.C. Partner with federal agencies, tribes, and neighboring states in long-term water resources management
Water Management & Development	10.A. Improve water-use efficiency and water conservation 10.B. Improve access to built storage 10.C. Encourage additional water reuse projects 10.D. Reach environmental outcomes with non-regulatory alternatives 10.E. Authorize and fund a water supply development program
Healthy Ecosystems	11.A. Improve watershed health, resiliency, and capacity for natural storage 11.B. Develop additional instream protections 11.C. Prevent and eradicate invasive species 11.D. Protect and restore instream habitat and habitat access for fish and wildlife
Public Health	12.A. Ensure the safety of Oregon's drinking water 12.B. Reduce the use of and exposure to toxics and other pollutants 12.C. Implement water quality pollution control plans
Funding	13.A. Fund development and implementation of Oregon's IWRS 13.B. Fund water resources management at the state level 13.C. Fund communities needing feasibility studies for water conservation, storage & reuse projects

Photo: Susan Douthit, OWRD

Oregon's Integrated Water Resources Strategy contains a number of recommended actions, which taken together, provide a blueprint for the State of Oregon to follow in order to understand and meet its instream and out-of-stream water needs. The reality of our national, state, and local economic situation means that implementation of these Recommended Actions may not be as robust or aggressive as desired.

However, the current economy cannot curb Oregon's commitment to meeting current and future water needs, which include economic growth and environmental protection. Oregon's goal is to secure successful outcomes in both of these areas, and the Integrated Water Resources Strategy offers a series of "next steps" to get us there.

This Strategy offers an opportunity to take a long-term approach to water resources management, enumerating next steps according to five- and ten-year outcomes.

Five-Year Outcome (2012-2017)	Provide essential services and conduct in-basin work, improving Oregon's ability to understand and meet its water needs.
Ten-Year Outcome (2017-2022)	Strengthen essential services and in-basin work, positioning Oregon to address emerging issues that affect our water needs and supplies.

The "Next Steps," enumerated here, require attention during the implementation phase (2012-17). Some steps are already underway, either as part of ongoing efforts, or because they do not require additional funding or authorizations from the Oregon Legislature. Some steps require assistance from the Oregon Legislature, which meets next in 2013. Other steps have been deferred until 2015, in order to implement the Integrated Water Resources Strategy in stages.

A more detailed workplan, with more information about the likely lead agency, staffing, and budget requirements, will emerge over the next several months. Such a workplan will require regular updates in order to reflect actions the Oregon Legislature, state agencies, and other partners have taken in support of the Strategy.

How Oregon goes about implementing these steps is important as well. The State has made commitments on a number of fronts, including accountability, a balanced approach, collaboration, an open public process, reasonable cost, science-based approaches, streamlining, and other principles memorialized as part of the Strategy's development. Policy-makers responsible for implementation have a duty to conduct the next phase as carefully as they did in the development of the Strategy.

The guiding principles follow:

- *Accountable and Enforceable Actions:* Ensure that actions comply with existing water laws and policies. Actions should include better measurement and enforcement tools to ensure desired results.
- *Balance:* The Strategy must balance current and future instream and out-of-stream needs supplied by all water systems (above ground and below ground). Actions should consider and balance tradeoffs between ecosystem benefits and traditional management of water supplies.
- *Collaboration:* Support formation of regional, coordinated, and collaborative partnerships that include representatives of all levels of government, private and non-profit sectors, tribes, stakeholders, and the public. Collaborate in ways that help agencies cut across silos.
- *Conflict Resolution:* Be cognizant of and work to address longstanding conflicts.
- *Facilitation by the State:* The State should provide direction and maintain authority for local planning and implementation. Where appropriate, the State sets the framework, provides tools, and defines the direction.
- *Incentives:* Where appropriate, utilize incentive-based approaches. These could be funding, technical assistance, partnerships / shared resources, regulatory flexibility, or other incentives.
- *Implementation:* Actions should empower Oregonians to implement local solutions; recognize regional differences, while supporting the statewide strategy and resources. Take into account the success of existing plans, tools, data, and programs; do not lose commonsense approach; develop actions that are measurable, attainable, and effective.
- *Interconnection/Integration:* Recognize that many actions (e.g. land-use actions) in some way affect water resources (quality and/or quantity); recognize the relationship between water quantity and water quality; integrate participation of agencies and parties.
- *Public Process:* Employ an open, transparent process that fosters public participation and supports social equity, fairness, and environmental justice. Advocate for all Oregonians.
- *Reasonable Cost:* Weigh the cost of an approach with its benefits to determine whether one approach is better than another, or whether an approach is worth pursuing at all. Actions should focus on reducing the costs of delivering services to the state's residents, without neglecting social and environmental costs.
- *Science-based, Flexible Approaches:* Base decisions on best available science and local input. Employ an iterative process that includes "lessons learned" from the previous round. Establish a policy framework that is flexible. Build in mechanisms that allow for learning, adaptation, and innovative ideas or approaches.
- *Streamlining:* Streamline processes without circumventing the law or cutting corners. Avoid recommendations that are overly complicated, legalistic, or administrative.
- *Sustainability:* Ensure that actions sustain water resources by balancing the needs of Oregon's environment, economy, and communities.

Steps Already Underway

The implementation of a number of recommended actions has begun, with authorizations secured and funding already in place. Examples include the efforts to localize, or downscale, climate change data at the Oregon Climate Change Research Institute; these efforts are funded primarily by federal funds. Other information-related efforts include updated program materials, education and outreach at all age levels, and boat-inspection programs designed to find and eradicate invasive species.

Funding for water and wastewater related infrastructure is still available from Federal partners, although at declining rates. Funding for habitat restoration also continues via the Oregon Watershed Enhancement Board, with lottery funds as the source.

Work is scheduled to continue on the water quality and public health front, with continuation of programs at current funding levels to ensure drinking water safety, to reduce exposure to toxics, and to implement water quality pollution control plans.

Oregon now also has a modest track record in water supply development, with the establishment of the Umatilla Basin Aquifer Recovery Project. That project continues to develop into a commercially-sized application, and will likely continue to seek state investment as it grows to full build-out.

Next Steps Requiring Assistance from the Oregon Legislature in 2013

In order to position Oregon to better understand and meet its water needs now and into the future, the Integrated Water Resources Strategy makes a series of recommended actions that need assistance from the Oregon Legislature in the short term.

First, a better understanding of Oregon's physical water resources
This includes completion of additional groundwater basin studies that help us understand where Oregon's groundwater resources are located, their relationship to surface water ecosystems, and their sustainable yield. These efforts also include improved monitoring of groundwater, surface water, and habitat through improved instrumentation—additional dedicated monitoring wells and stream gages, the technical staff to operate the systems, and increased agency coordination.

Second, an improved understanding of Oregon's need for water
Recommended actions begin to close some fundamental gaps in our water rights system, such as authorizing the State to update the name on water right certificates, providing technical assistance to help customers with water-use measurement and reporting, and determining and protecting the flows needed to support instream needs.

Third, a better understanding of the coming pressures that affect our needs and supplies
Recommendations in this area place heavy emphasis on providing critical groundwater and climate change information to local communities and planners, so that they can understand how groundwater hydrology and potential changes in precipitation patterns may affect their access to and management of water.

Fourth, an improved ability to meet Oregon's current and future water resources needs
This includes developing tools so the State can partner with local communities to conduct place-based integrated, water resources planning. It also includes the authority and funding for the State to lead a more active water supply development program than in the past, notably in the purchase, conservation, storage, and development of water for both instream and out-of-stream purposes. It includes a variety of

traditional and non-traditional mechanisms to protect water quality, providing benefits to both public health and ecological health. Finally, the Strategy calls for stability and a renewed commitment to identifying funding sources that support Oregon's system of water resources management.

Next Steps Requiring Assistance from the Oregon Legislature in 2015

Not all of the Recommended Actions identified in the Integrated Water Resources Strategy are positioned for short-term implementation. Some requests will likely be deferred until the Oregon Legislature meets in 2015, because of interim steps planned in the meantime.

One example includes adjudication of pre-1909 claims. The Water Resources Department plans to complete its role in the Adjudication of the Klamath Basin by July 1, 2013. From there, the Department needs to work with stakeholders to develop a workplan to address the remaining un-adjudicated areas of the state.

By 2015, it will also be time to develop a new, long-range water demand forecast for the state. This will require a modest investment in technical studies.

Finally, by 2015, a significant amount of local, or downscaled, climate change data may available to present to communities, so that they can build the results into their local efforts to plan their water future.

The next rendition of Oregon's Integrated Water Resources Strategy is due in 2017.

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Dick Pedersen, Director
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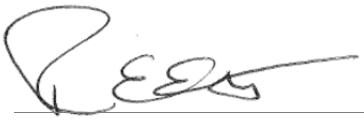

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ACRONYMS

AR	Artificial Recharge
ASR	Aquifer Storage and Recovery
BiOp	Biological Opinion
BMP	Best Management Practice
BOR	Bureau of Reclamation, U.S. Department of Interior
BPA	Bonneville Power Administration, U.S. Department of Energy
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
DCBS	Oregon Department of Consumer and Business Services
DEQ, ODEQ	Oregon Department of Environmental Quality
DLCD	Oregon Department of Land Conservation and Development
DOGAMI	Oregon Department of Geology and Mineral Industries
DRC	Deschutes River Conservancy
DSL	Oregon Department of State Lands
DWA	Deschutes Water Alliance
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
GDE	Groundwater Dependent Ecosystem
GWMA	Groundwater Management Area (DEQ designation)
HAB	Harmful Algae Bloom
IFA	Infrastructure Finance Authority
JWC	Joint Water Commission
MGD	Million Gallons per Day
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service, U.S. Department of Agriculture
OAR	Oregon Administrative Rule
OBDD	Oregon Business Development Department
OCCRI	Oregon Climate Change Research Institute
ODA	Oregon Department of Agriculture
ODE	Oregon Department of Energy
ODF	Oregon Department of Forestry
ODFW	Oregon Department of Fish and Wildlife
ODOE	Oregon Department of Energy
ODOT	Oregon Department of Transportation
OHA – DWP	Oregon Health Authority (formerly DHS) – Drinking Water Program
OMD - OEM	Oregon Military Department – Office of Emergency Management
OPRD	Oregon Parks and Recreation Department
ORS	Oregon Revised Statutes
OWEB	Oregon Watershed Enhancement Board
OWSCI	Oregon Water Supply and Conservation Initiative
SIGPOD	Significant Point of Diversion

SWCD	Soil and Water Conservation District
TMDL	Total Maximum Daily Load
UGB	Urban Growth Boundary
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFW	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WQRP	Water Quality Restoration Plan
WRC	Oregon Water Resources Commission
WRD, OWRD	Oregon Water Resources Department
WRIA	Water Resource Inventory Areas (State of Washington)

Oregon's Integrated Water Resources Strategy

Framework

Goal 1: Improve Our Understanding of Oregon's Water Resources

Understand Water Resources Today

OBJECTIVES

CRITICAL ISSUES

- Further Understand Limited Water Supplies & Systems *(groundwater, surface water and their interaction)*
- Improve Water Quality & Water Quantity Information
- Further Understand Our Water Management Institutions

RECOMMENDED ACTIONS

Understanding Water Resources / Supplies / Institutions

- 1a. Conduct additional groundwater investigations
- 1b. Improve water resource data collection and monitoring
- 1c. Coordinate inter-agency data collection, processing, and use in decision-making

Goal 1 (continued)

Understand Instream and Out-of-Stream Needs

CRITICAL ISSUES

- Further Define Out-of-Stream Needs / Demands *(i.e., diverted water)*
- Further Define Instream Needs / Demands *(i.e., left-in-place water)*

RECOMMENDED ACTIONS

Understanding Oregon's Out-of-Stream Needs/Demands

- 2a. Update long-term water demand forecasts 🕮
- 2b. Improve water-use measurement & reporting
- 2c. Determine pre-1909 water right claims
- 2d. Update water right records with contact information
- 2e. Update Oregon's water-related permitting guide

Understanding Oregon's Instream Needs/Demands

- 3a. Determine flows needed (quality & quantity) to support instream needs 🕮
- 3b. Determine needs of groundwater dependent ecosystems 🕮

Goal 1 (continued)

Understand the Coming Pressures That Affect Our Needs and Supplies

OBJECTIVES

CRITICAL ISSUES

- Economic Development
- Water & Energy Nexus
- Water & Land Use Nexus
- Population Growth
- Climate Change
- Infrastructure
- Education & Outreach

RECOMMENDED ACTIONS

The Water-Energy Nexus

- 4a. Analyze the effects on water from energy development projects & policies 🕮
- 4b. Take advantage of existing infrastructure to develop hydroelectric power
- 4c. Promote strategies that increase/integrate energy & water savings 🕮

Climate Change

- 5a. Support continued basin-scale climate change research efforts 🕮
- 5b. Assist with climate change adaptation and resiliency strategies 🕮

Economic Development & Population Growth

(See Actions 2.A. and 3.A.)

The Water and Land Use Nexus

- 6a. Improve integration of water Information into land use planning (& vice versa)
- 6b. Update state agency coordination plans
- 6c. Encourage low-impact development practices 🕮

Infrastructure

- 7a. Develop and upgrade water & wastewater infrastructure
- 7b. Encourage regional (sub-basin) approaches to water and wastewater systems

Education and Outreach

- 8a. Support Oregon's K-12 environmental literacy plan
- 8b. Provide education and training for Oregon's next generation of water experts 🕮
- 8c. Promote community education and training opportunities 🕮
- 8d. Identify ongoing water-related research needs 🕮

Goal 2: Meet Oregon's Water Resource Needs

Meet Oregon's Instream and Out-of-Stream Needs

CRITICAL ISSUES

- Place-Based Efforts
- Water Management & Development
- Healthy Ecosystems
- Public Health
- Funding

RECOMMENDED ACTIONS

Place-Based Efforts

- 9a. Undertake place-based integrated, water resources planning
- 9b. Coordinate implementation of existing natural resource plans
- 9c. Partner with federal agencies, tribes, and neighboring states in long-term water resources management

Water Management & Development

- 10a. Improve water-use efficiency and water conservation 🕮
- 10b. Improve access to built storage 🕮
- 10c. Encourage additional water reuse projects 🕮
- 10d. Reach environmental outcomes with non- regulatory alternatives 🕮
- 10e. Authorize and fund a water supply development program

Healthy Ecosystems

- 11a. Improve watershed health, resiliency, and capacity for natural storage
- 11b. Develop additional instream protections
- 11c. Prevent and eradicate invasive species
- 11d. Protect and restore instream habitat and habitat access for fish & wildlife

Public Health

- 12a. Ensure the safety of Oregon's drinking water
- 12b. Reduce the use of and exposure to toxics and other pollutants
- 12c. Implement water quality pollution control plans

Funding

- 13a. Fund development & implementation of Oregon's IWRS
- 13b. Fund water resources management at the state level
- 13c. Fund communities needing feasibility studies for water conservation, storage, and reuse projects

KEY: 🕮 Ongoing need for applied research

THE COMMISSION'S VISION FOR THE STRATEGY

A statewide integrated water resources strategy will bring various sectors and interests together to work toward the common purpose of maintaining healthy water resources to meet the needs of Oregonians and Oregon's environment for generations to come.

THE POLICY ADVISORY GROUP'S VISION FOR THE STRATEGY

Everywhere in our State, we see healthy waters, able to sustain a healthy economy, environment, and cultures & communities.
Healthy waters…are abundant and clean. A healthy economy…is a diverse and balanced economy, nurturing and employing the State's natural resources and human capital to meet evolving local and global needs, including a desirable quality of life in urban and rural areas. A healthy environment…includes fully functioning ecosystems, including headwaters, river systems, wetlands, forests, floodplains, estuaries, and aquifers. Healthy cultures and communities… depend on adequate and reliable water supplies to sustain public health, safety, nourishment, recreation, sport, and other quality of life needs.

PRINCIPLES TO GUIDE THE STRATEGY

Accountable and Enforceable Actions: Ensure that actions comply with existing water laws and policies. Actions should include better measurement and enforcement tools to ensure desired results.

Balance: The Strategy must balance current and future instream and out-of-stream needs supplied by all water systems (above ground and below ground). Actions should consider and balance tradeoffs between ecosystem benefits and traditional management of water supplies.

Collaboration: Support formation of regional, coordinated, and collaborative partnerships that include representatives of all levels of government, private and non-profit sectors, tribes, stakeholders, and the public. Collaborate in ways that help agencies cut across silos.

Conflict Resolution: Be cognizant of and work to address longstanding conflicts.

Facilitation by the State: The State should provide direction and maintain authority for local planning and implementation. Where appropriate, the State sets the framework, provides tools, and defines the direction.

Incentives: Where appropriate, utilize incentive-based approaches. These could be funding, technical assistance, partnerships / shared resources, regulatory flexibility, or other incentives.

Implementation: Actions should empower Oregonians to implement local solutions; recognize regional differences, while supporting the statewide strategy and resources. Take into account the success of existing plans, tools, data, and programs; do not lose commonsense approach; develop actions that are measurable, attainable, and effective.

Interconnection/Integration: Recognize that many actions (e.g. land-use actions) in some way affect water resources (quality and/or quantity); recognize the relationship between water quantity and water quality; integrate participation of agencies and parties.

Public Process: Employ an open, transparent process that fosters public participation and supports social equity, fairness, and environmental justice. Advocate for all Oregonians.

Reasonable Cost: Weigh the cost of an approach with its benefits to determine whether one approach is better than another, or whether an approach is worth pursuing at all. Actions should focus on reducing the costs of delivering services to the state's residents, without neglecting social and environmental costs.

Science-based, Flexible Approaches: Base decisions on best available science and local input. Employ an iterative process that includes" lessons learned" from the previous round. Establish a policy framework that is flexible. Build in mechanisms that allow for learning, adaptation, and innovative ideas or approaches.

Streamlining: Streamline processes without circumventing the law or cutting corners. Avoid recommendations that are overly complicated, legalistic, or administrative.

Sustainability: Ensure that actions sustain water resources by balancing the needs of Oregon's environment, economy, and communities.

IMPLEMENTING THE STRATEGY

An iterative process will help us evaluate whether the recommended actions meet the goals and objectives defined above. The process will include monitoring the implementation of recommended actions, a commitment to resolving conflicts that arise during the course of implementation, providing feedback on any successes or shortcomings, and evolving or adapting to new information or resources. As we learn lessons from the first round of implementation, we can adjust the Strategy as needed through formal adoption every five years.

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