Oregon
Kate Brown, Governor

**Water Resources Department**
725 Summer St NE, Suite A
Salem, OR 97301
(503) 986-0900
Fax (503) 986-0904

**MEMORANDUM**

TO: Water Resources Commission

FROM: Thomas M. Byler, Director

SUBJECT: Agenda Item A, December 7, 2017
Water Resources Commission Meeting

**Consideration for Adoption: Oregon's 2017 Integrated Water Resources Strategy**

## I. Introduction

During this agenda item, the Commission will consider adoption of the 2017 Integrated Water Resources Strategy (Strategy). IWRS Project Team members will also share information on the process of developing the Strategy and their agencies' perspectives.

## II. Background

Oregon's 2012 Integrated Water Resources Strategy is now five years into implementation. The focus of this first Strategy was on the fundamental data and science that underpins water-related decisions made every day. It provided a place to document the state's successes and challenges in the water arena and created the momentum needed to secure the support needed to advance water resources management and protection across agencies. Since its adoption, Oregon has made a number of advancements in water resources management.

The Strategy is meant to be a living document, developed and implemented using an iterative process. The authorizing statutes require a review and update of the Strategy every five years.

Today, the Commission has, for its consideration, a 2017 Strategy that has been updated according to the parameters set forth in Oregon Revised Statutes (ORS) 536.220. Pursuant to the law, the Oregon Board of Agriculture, Oregon Environmental Quality Commission, and the Fish and Wildlife Commission were notified of the proposed adoption.

## III. Overview of the 2017 Strategy

The 2017 Strategy continues to build upon the goals, objectives, guiding principles, and actions of the first Strategy. The fundamental purpose of this document is to better understand and meet Oregon's water needs—instream and out-of-stream—while integrating water quantity, water quality, and ecosystem needs.

The 2017 Strategy renews its emphasis on data and information and highlights examples where science is and should continue to be integrated into public policy. The 2017 Strategy introduces nine new recommended actions:

- Planning and preparing for droughts, floods, and the Cascadia earthquake [5.5A, 5.5B, 5.5C]
- Ensuring public safety/dam safety [7.C]
- Providing an adequate presence in the field [10.F]
- Strengthening water quantity and water quality permitting programs [10.G]
- Developing additional groundwater protections [11.E]
- Investing in local or regional water planning efforts [13.C]
- Investing in implementation of water resources projects [13.E]

Contents of the 2017 Integrated Water Resources Strategy include:

- Table of Contents
- Water Resources Commission's Adoption Resolution
- Governor's Foreword
- Introduction
- Chapter 1: Understand Water Resources Today
- Chapter 2: Understand Instream and Out-of-Stream Needs
- Chapter 3: Understand the Coming Pressures that Affect our Needs & Supplies
- Chapter 4: Meet Instream and Out-of-Stream Needs
- Conclusion
- Acronyms
- Acknowledgements
- IWRS Framework

## IV. Revisions to the April 2017 Public Review Draft

A formal comment period occurred April through July 2017. Staff briefed the Commission and public on its planned approach for addressing public comment during the August 2017 Commission meeting. Staff met with the Commission's IWRS subcommittee in early October to walk through a revised version of the 2017 Strategy.

The April 2017 Public Review Draft has been revised to reflect written comments submitted during the formal public comment period. Several Department staff, including state agency partners, assisted with the revision process. Refer to a completed "Acknowledgements" section, beginning on Page 171 of the 2017 Strategy that formally recognizes the contributions of staff and partners.

Attached to this staff report are two versions of the Final Draft, dated November 6, 2017. Attachment 1 is a "Clean Draft" and Attachment 2 is a "Revised Draft." The two documents are identical, except the Revised Draft uses red text, in lieu of track changes, to signal where revisions were made to the April 2017 Public Review Draft. In other words, if text was revised, inserted, or deleted, red text signals to the reader where to look for those changes.

Several commenters made a request for additional content in the 2017 Integrated Water Resources Strategy. Department staff have noted below in sub-section (a) where larger new sections were added, and (b) where larger revisions occurred. The Department also added some highlight stories to the proposed Final Draft, which are outlined below in sub-section (c). This is not an exhaustive list of all changes, but rather areas worth noting. To review all changes, refer to Attachment 2.

a). New Sections:

- Introduction (Pgs. 10-11) – a new "cross-cutting issues" section discussing groundwater; climate change and extreme events; funding and investments; and collaborative solutions.
- Ch. 1 (Pg. 24) – a new section and map on how Oregon monitors and evaluates surface water quality."
- Ch. 1 (Pg. 28) – new content on the Agricultural Water Quality Management Act and the Forest Practices Act.
- Ch. 1 (Pgs. 32-33) – new sections titled, "Is it Safe to Swim?" and "Is it Safe to Eat the Fish?" to broaden the narrative on how public health is protected.
- Ch. 1 (Pg. 35) – expanded description of the State's Lidar program, including a new map, courtesy of DOGAMI.
- Ch. 3(Pg. 66) –a short summary of an ongoing project by the Department of Land Conservation and Development to inventory assets along the Oregon Coast that may be affected by sea-level rise.
- Ch. 3 (Pg. 68) – a new section on climate change adaption and resiliency strategies that cross-references to other recommended actions throughout the 2017 Strategy.
- Ch. 3 (Pg. 71) – a reference to "snow drought" to supplement other established definitions of drought.
- Ch. 3 (Pg. 74) – a new/revised section on the drought declaration process and use of drought response tools. The drought section was revised to clarify which recommendations were supported by the Drought Task Force and Policy Advisory Group (Pg.74) and includes new background on the Drought Readiness Council, including potential opportunities to improve drought response at the state level (Pg. 75).
- Ch. 3 (Pg. 83-84) – new reference to Goal 3 (Agricultural Lands) and Goal 4 (Forest Lands) in the land-use planning section, using existing content and new text.
- Ch. 3 (Pg. 100) – a new section on the numerous education and outreach programs offered by the Oregon State Marine Board.
- Ch. 4 (Pg. 113) – a new section on "Water Conservation within Industry" to supplement existing water conservation sections focused on within the home, cities, and agriculture.
- Ch. 4 (Pg. 122) – a new section on desalination as a non-traditional approach to meeting water needs.
- Ch. 4 (Pg. 133) – a reference to DEQ's Outstanding Resource Water designation for the North Fork of the Smith River, which was approved by the Environmental Quality Commission in July 2017.
- Ch. 4 (Pg. 140) – a discussion on potential sources of groundwater contamination.

- Ch. 4 (Pg. 143) – a highlight box showing where the public can find data and information on public drinking water systems.
- Ch. 4 (Pg. 154) – a high-level bulleted list of implementation activities that reflect the day-to-day operations of state agencies that require funding (e.g. monitoring, technical studies, field work, regulatory programs).

b). Revised Sections:

- Ch. 1 (Pg. 31) – revised the "Lead in Drinking Water" section, based on public comments and assistance from the Oregon Health Authority to better reflect the most common contaminants in drinking water.
- In Ch. 2 (Pg. 46) – Recommended Action 2.A was revised to read, "Determine Unadjudicated Water Right Claims." In the 2012 Strategy and April 2017 Public Review Draft, it read, "Determine Pre-1909 Water Right Claims." Using "unadjudicated" better reflects the varied timelines regarding establishment of groundwater and surface water permitting laws.
- Ch. 2 (Pg. 52) – revised section on what a "Long-Term Instream Demand Forecast" could look like.
- Ch. 4 (Pg. 143) – revised the "source water protection" section.
- Ch. 4 (Pg. 148) – revised the "Contaminated and Hazardous Sites" section.
- Ch. 4 (Pg. 151-152) – revised the section on nonpoint sources of pollution to add more context and clarify the State's program, along with mention of federal programs under the Farm Bill.
- Conclusion (Pg. 168) – removed list of recommended actions and their implementation bullets to save space and avoid duplication errors. A separate reference document can be developed with this type of summary information at a later time.

c). Highlight Stories:

The 2012 Integrated Water Resources Strategy included special highlights showing innovative or partnership approaches throughout the state. These feature stories were a popular edition to the 2012 Strategy and helped to illustrate the importance of public and private partners in carrying out the goals and objectives of the Strategy. For the 2017 Strategy, the Department worked with local partners to draft new stories highlighting collaborative partnerships and innovative approaches. Nine stories are found throughout the document, as outlined below:

- Pg. 34 – "Community-Led Water Quality Testing," highlighting Surfrider Foundation's volunteer water quality monitoring work along the Oregon coast.
- Pg. 53 – "Connecting Consumers to Salmon-Safe Products and Places," that shows a few examples of Salmon-Safe certifications.
- Pg. 62 – "Saving Water and Energy Go Hand in Hand," highlighting work under WyEast RC&D's Safe Water Safe Energy Program with irrigated agriculture.
- Pg. 88 – "Green Infrastructure Projects Designed to Improve Water Quality," discussing innovative natural treatment processes at wastewater plants in Roseburg and Forest Grove.

- Pg. 114 – "Modernizing Oregon's Irrigation Infrastructure," highlighting efforts by Farmers Conservation Alliance and Energy Trust of Oregon to improve irrigation infrastructure.
- Pg. 123 – "Restoration for Compliance in the Rogue River and Beyond," highlighting efforts of several partners working on water quality trading and riparian restoration.
- Pg. 137 – "Investing in Habitat for Native Migratory Fish in Oregon," highlighting work by ODOT, Willamette Partnership, and The Nature Conservancy on a pilot mitigation program for fish passage.
- Pg. 147 – "Pesticide Stewardship Partnership in the Clackamas River Basin," highlighting activities of several local and state partners to improve and protect water quality through voluntary, innovative approaches.
- Pg. 157 – "Planning for Future Water Needs for Rivers, Farms, and Cities," highlighting collaborative planning efforts in the Upper Deschutes River Basin.

## V. Developing the Final Design & Layout

The Department is currently designing the final layout of the 2017 Integrated Water Resources Strategy, adding images to highlight stories, and creating the covers and themes for the front cover and various chapters. Two Oregon artists – April Waters and Susan Luckey Higdon – have granted permission to feature certain pieces from their collection of artwork. Both artists specialize in water landscapes of the Northwest.

A foreword from the Governor is currently in development and will be added, once completed. Following adoption, the Department will prepare copies for printing and distribution as well as an online version. Staff will also draft an Executive Summary.

## VI. Review and Discussion of the Adoption Resolution

The Department has drafted an Adoption Resolution for the Commission's consideration. Please refer to Pages 5-6 of the 2017 Strategy. During the meeting, the Commission will discuss whether any changes need to be made to the Adoption Resolution.

## VII. Adoption of the 2017 Strategy

During this portion of the agenda, the Commission will have an opportunity to make changes to the 2017 Integrated Water Resources Strategy. The Commission may also consider public testimony during this portion of the meeting.

Following the discussion, the Commission will be asked to formally adopt the 2017 Integrated Water Resources Strategy. The Commission may consider the following options:

- Option 1: Adopt the 2017 Strategy as proposed in Attachment 1.
- Option 2: Adopt the 2017 Strategy as proposed with Attachment 1, with modifications.
- Option 3: Do not adopt the 2017 Strategy, directing staff to return in 2018 with a revised 2017 Strategy for the Commission's consideration.

## VIII. Recommendation

The Director recommends Option 1: Adopt the 2017 Strategy as proposed in Attachment 1.

Attachments:
1. November 6, 2017 Final Clean Draft of the 2017 Strategy
2. November 6, 2017 Final Revised Draft of the 2017 Strategy

Alyssa Mucken
(503) 986-0911

Brenda Bateman
(503) 986-0879

# Oregon's 2017 Integrated Water Resources Strategy

## Final Clean Draft:  11-06-2017

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

www.oregon.gov/owrd
waterstrategy@wrd.state.or.us

December 2017

# Table of Contents



* Note (11/22/2017): A final "Adoption Resolution" has been added to this Nov. 6, 2017 Final Clean Draft, along with a completed "Acknowlegements" section.

This page left intentionally blank.

# OREGON WATER RESOURCES COMMISSION

## Resolution Adopting the State's Integrated Water Resources Strategy

Whereas, the Oregon Water Resources Commission adopted Oregon's first Integrated Water Resources Strategy in 2012, carrying out its vision of bringing various sectors and interests together to work toward the common purpose of maintaining healthy water resources to meet the needs of Oregonians and the environment for generations to come;

Whereas, extreme weather events in recent years—droughts, fires, winter storms, and floods—continually remind us that water-related challenges are here and will only increase in the future;

Whereas, future events such as climate change and earthquakes may influence water availability, water use, and water infrastructure;

Whereas, the Water Resources Commission desires to continue, through updates to the Strategy, a strong tradition of scientific integrity, forward-looking public policy, and robust public participation in Oregon;

Whereas, by design, this 2017 Strategy retained the original vision, goals, objectives, and guiding principles from the 2012 version, with the intent to update information, fill important gaps, and strengthen ideas by shoring up or adding new recommendation actions, where needed;

Whereas, the institutions created to develop the Strategy have continued to lend their voices and knowledge—the four-agency Project Team, the 18-member Policy Advisory Group, the 18-entity Agency Advisory Group, and 10-agency Federal Liaison Group;

Whereas, the citizens of Oregon continue to demonstrate awareness and knowledge of water issues, showing strong support for collaborative solutions and contributing to the conversation through seven open houses and dozens of survey responses, attending four policy advisory group meetings, and submitting 285 public comments during a 90-day public comment period;

Whereas, our fellow Boards and Commissions have continued to support this work, the process, and product—the Environmental Quality Commission, Fish and Wildlife Commission, and the Board of Agriculture;

Whereas, the 2017 Integrated Water Resources Strategy features water-related artwork, photos, and quotes from Oregonians;

Whereas, the 2017 Integrated Water Resources Strategy includes a suite of Recommended Actions to improve our understanding of water resources, to define our collective instream and out-of-stream needs—including water quantity, water quality, and ecosystems needs—and to address the coming pressures that may affect these resources and needs;

Whereas, Oregon's update to the 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 2017 Integrated Water Resources Strategy on this Seventh Day of December, 2017.

| | |
|---|---|
| John E. Roberts, Chair<br>Southwest Region | Raymond L. Williams, Vice Chair<br>Eastside at Large |
| Robert P. Baumgartner<br>Northwest Region | Eric J. Quaempts<br>North Central Region |
| Bruce R. Corn<br>Eastern Region | Carol A. Whipple<br>West Central Region |
| Meg Reeves<br>Westside at Large | |

# Foreword

**Placeholder for the Foreword**

**Placeholder for the Foreword**

# INTRODUCTION

Oregon's Integrated Water Resources Strategy (IWRS, or "the Strategy") is now five years into implementation. At the time of its adoption by the Water Resources Commission in 2012, Oregon was one of a few states without a statewide water plan. 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.

Oregon's first Strategy provided a place to document the state's successes and challenges in the water arena. The development of the Strategy proved the importance of a robust public process, thoughtful and science-based policy development, and committed leadership from both the Executive and Legislative branches of government. "Water" often competes for General Fund dollars with other important state services. The original Strategy created the momentum needed to secure the support and legal authorities to advance water resources management and protection across agencies.

The focus of the original Strategy was on the fundamental data and science that underpin water-related decisions made every day. Ideas that were merely kernels of thought in the 2012 Strategy have blossomed into important programs that represent how we do business in Oregon today. Since the release of the 2012 Strategy, Oregon has made a number of advancements in water resources management, including:

- Dedicated funding for measurement and monitoring, installing new observation wells, initiating groundwater investigations, deploying new stream gages, and expanding a cost-share fund for water use measurement devices
- Improved effectiveness monitoring on forest lands
- Established new water resources planning capacity at the Department of Agriculture and the Department of Environmental Quality
- Expanded invasive species prevention efforts through the use of boat inspection stations
- Initiated new instream flow studies and protected additional rivers by designating scenic waterways, establishing outstanding resource waters, and applying for new instream water rights
- Expanded the Pesticide Stewardship Partnership approach to new areas and continued toxics reduction efforts
- Established a statewide groundwater quality monitoring program
- Established a new planning program called place-based, integrated water resources planning with guidelines, funding, and assistance to initially support four communities with unique water challenges
- Launched a new funding program called the Water Resources Development Program. It offers grants, loans, and technical assistance for planning, feasibility studies, and water projects
- Published guidance and reports to help customers with water-related permitting, allocations of conserved water, water management and conservation plans, and long-term demand forecasts
- Added capacity for inter-agency coordination and collaboration

## The 2017 Edition

The Strategy is meant to be a living document, developed and implemented using an iterative process. The authorizing statute (ORS 536.220) requires a review and update of the Strategy every five years. This 2017 Strategy continues to build upon the goals, objectives, guiding principles, and actions of the first Strategy, allowing the Water Resources Commission and its sister boards and commissions to continue championing it as before.

The fundamental purpose of this document is to better understand and meet Oregon's water needs—both consumptive and environmental—while including water quantity, water quality, and ecosystem needs.

The 2017 Strategy renews its emphasis on data and information, describing ways in which the state and its partners can infuse science into their decision-making. Relying on a foundation of science means that information must be usable and accessible. This document highlights examples where science is and should continue to be integrated into public policy—through analysis and studies; through delivery to internet and mobile devices; during training, education, and outreach; as inputs to statute and rule; as inputs into permitting, regulatory, and funding decisions; and as a basis for water supply, water efficiency, and habitat restoration projects.

The 2017 Strategy introduces nine new recommended actions:

- Planning and preparing for droughts [5.5A], floods [5.5B], and the Cascadia earthquake [5.5C]
- Ensuring public safety/dam safety [7.C]
- Providing an adequate presence in the field [10.F]
- Strengthening water quantity and water quality permitting programs [10.G]
- Developing additional groundwater protections [11.E]
- Investing in local or regional water planning efforts [13.C]
- Investing in implementation of water resources projects [13.E]

The 2017 Strategy once again spells out "what" generally needs to happen, but not the finer details of implementation. For that level of detail, agencies will need to engage their stakeholders in a workplan exercise that specifies priorities, necessary budget resources, staffing, and timing.

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—financial or technical— or new policies could serve as powerful tools for progress. It also identifies where public and private partnerships could stretch our dollars and further instream and out-of-stream efforts. Just as importantly, the 2017 Integrated Water Resources Strategy does not remove or jeopardize existing water rights or other local, state, tribal, and federal authorizations. The Strategy does not relinquish any existing authorities.

## Cross-Cutting Issues

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

**Groundwater:** The health and future of Oregon's groundwater resources were featured in several important venues during 2016-17, including discussions of the Water Resources Commission, media articles, a Secretary of State audit, testimony before legislative committees, and discussions of the Integrated Water Resources Strategy Policy Advisory Group. The Water Resources Commission and Policy Advisory Group have both called for a long-term plan for sustainable groundwater management.

Oregon agencies monitor and manage groundwater at the state level, tracking groundwater-level trends and groundwater quality, providing information to local planners and other decision-makers, making science-based permitting decisions, and managing surface water and groundwater conjunctively. The 2017 Strategy contains recommended actions to advance the collection and processing of groundwater data, as well as the management and protection of groundwater resources. Recommended actions throughout the document that touch upon land-use planning, infrastructure, permitting, field presence, environmental health, public health, and funding all have a groundwater nexus.

**Climate Change and Extreme Events:** Oregon cannot simply rely on the past to predict the future. We must develop a broader understanding of the range of hydrologic possibilities. The 2017 Strategy discusses a changing climate, calling for continuous monitoring of its effects and actions that are necessary to address climate change.

The Governor's 2015 Executive Order 15-09 focused on drought resiliency, instructing agencies to include the topic in the 2017 Strategy. The resulting recommendations point to a suite of tools and approaches, including increased water conservation and efficiency efforts, expanded natural and built storage, and strengthened resiliency of riparian areas, forest lands, wetlands, and floodplains.

**Funding and Investments:** None of the recommended actions in this document can succeed without investment of dollars, time, energy, and expertise. For reasons of brevity, the reader will not see funding requests in each chapter; however, assume that all of the recommended actions require some level of funding support. Recommended Action 13.B, in particular, notes where state agencies have responsibilities that require budget dollars for successful implementation. Today, the agencies that protect and manage Oregon's natural resources receive less than two-percent of the General Fund. Water management receives an even thinner slice of that investment.

**Collaborative Solutions:** As members of the 2016 Policy Advisory Group and the public pointed out, the "place" where communities come together to collaborate with public agencies, academic institutions, non-profits and private sector partners to address water challenges is fertile ground for testing and trying the approaches described throughout the Integrated Water Resources Strategy.

These are places where agencies and citizens can collaborate on data collection and monitoring; where stakeholders can help quantify water needs; where land-use planning and zoning influence water resources; and where we improve our resiliency to extreme weather events. A diverse array of interests are collaborating on water issues – some are planning for future water needs, while others are developing innovative projects or programs that provide multiple benefits. Collaborative approaches to water are featured throughout the Strategy.

## Organization of the Document

Oregon's 2017 Integrated Water Resources Strategy provides a blueprint to help the state focus its efforts around two key goals—improving our understanding of Oregon's water resources, and meeting Oregon's water resources needs.

The document is organized into four main chapters that cover the four objectives of the Strategy. Both the goals and the objectives reflect the authorizing legislation.

Goal 1: Improve our understanding of Oregon's water resources
- Chapter 1 (Objective 1): Understand water resources today
- Chapter 2 (Objective 2): Understand instream and out-of-stream needs
- Chapter 3 (Objective 3): Understand the coming pressures that affect our needs and supplies

Goal 2: Meet Oregon's water resources needs
- Chapter 4 (Objective 4): Meet Oregon's instream and out-of-stream needs

Within each chapter are sections that describe the "critical issues" facing the state. These were developed and vetted with support from advisory groups, agencies, and public input. Each critical issue is addressed by a series of "recommended actions." Altogether, the 2017 Integrated Water Resources Strategy contains 51 recommended actions, each one supported with a set of bulleted items about how one might implement that action. Each chapter concludes with an at-a-glance summary of the recommended actions contained in each chapter.

## A Vision for the Future

Changes are coming as a result of aging water infrastructure, a warming climate, and an influx of people moving to Oregon from warmer, drier regions. These changes are already evident in the water scarcity that persists throughout the state, particularly on the east side. This scarcity affects the decisions of farmers and ranchers, cities, industry, and other water users, and places increased pressure on the ecological health of river systems and aquifers and the plant and animal species that depend on them for survival.

The already-existing tensions between competing uses and priorities are likely to be exacerbated by these coming pressures, making them even more challenging to reconcile. With this in mind, this draft Strategy lays out a number of proactive recommendations that help meet our current and future water needs.

The Policy Advisory Group that helped craft the original Strategy offered a vision that still holds true today, noting that:

> **"50 years from now, our vision is to see everywhere in our state 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.
>
> **~ Policy Advisory Group (2010)**

The Policy Advisory Group that helped craft the 2017 Strategy offered more specific observations about the water challenges we face today and how to address them:

> **"Water is a finite resource with growing demands; water scarcity is a reality in Oregon. Water-related decisions should rest on a thorough analysis of supply, the demand / need for water, the potential for increasing efficiencies and conservation, and alternative ways to meet these demands."**
>
> **~ Policy Advisory Group (2016)**

# CHAPTER 1

## Understand Water Resources Today

Water is one of our 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.

Oregon has a continuing need to understand its water resources. This includes the form and timing of precipitation, the amount of streamflow, the location and volume of groundwater, the quality of the water, and overall accessibility to communities, fish, and wildlife. The state and its partners serve as stewards of this public resource—managing water simultaneously for economic development, human health and safety, and for environmental protection.

The 2017 Integrated Water Resources Strategy continues to be a product of inter-agency collaboration. Chief among these efforts is a commitment to thoughtful and robust data collection, analysis, and sharing information with those engaged in water management and decision-making.

**Quick Links to Main Sections:**

# Critical Issue – Further Understand Limited Water Supplies and Systems

In an average year, Oregon's lakes, streams, and aquifers accommodate an estimated 100 million acre-feet of water.[1] Water moves through the land, rock, soils, plants, mountains and valleys at different rates and volumes, fluctuating throughout the year. The dynamic nature of water makes it challenging to quantify. Understanding how this complex system works is the key to effectively managing Oregon's water resources.

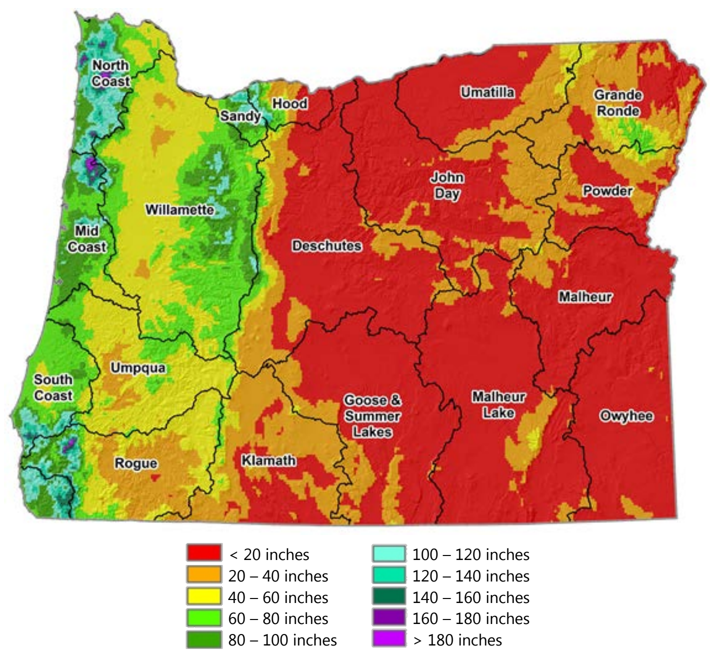
## Precipitation

Oregon receives a majority of its precipitation in the fall and winter. In general, Oregon has a rather mild winter climate. The climate of the western third of the state is characterized by moderate temperatures, wet winters, and dry summers; about 78 percent of the annual precipitation occurs in the period October to March. The eastern portion of the state, on the other hand, has greater extremes of temperature but somewhat less seasonal variation in precipitation. On the east side, about 65 percent of the precipitation occurs in the period October to March.

The Cascade Range, about 90 miles inland from the Pacific Ocean, lies parallel to the coastline and acts as a natural barrier to marine air masses and the prevailing westerly winds. This causes significant statewide variation in annual rainfall, as shown in Figure 1-1. In western Oregon, average annual precipitation ranges from 200 inches in places in the Coast Range to less than 40 inches on the Willamette Valley floor, and less than 10 inches in parts of north-central and south-eastern Oregon. In the winter, much of the precipitation falls as snow at altitudes above 3,500 feet.

Precipitation does not arrive all at once, but in a series of seasonal storms or events, each generating a unique combination of responses from the effected watersheds. These responses are influenced by numerous physical characteristics within the watershed that in turn affect surface water runoff patterns and groundwater recharge, as well as plant uptake and evaporation.

**Figure 1-1: Average Annual Precipitation**

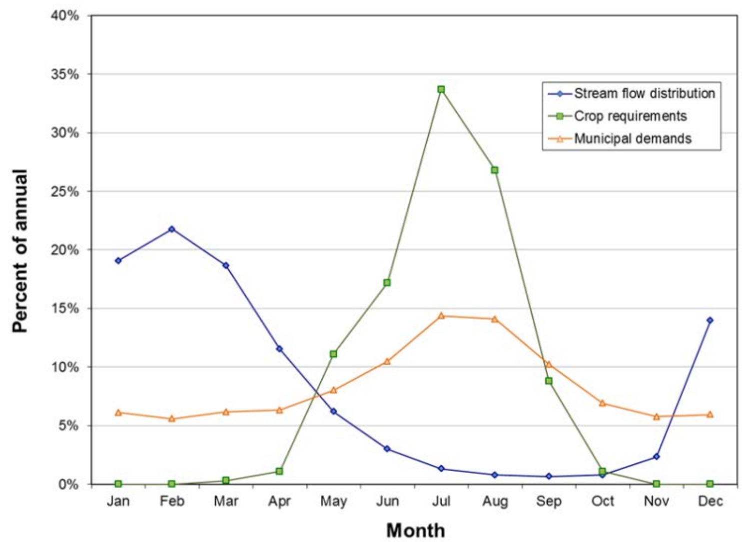



## Surface Water

Surface water runoff is relatively abundant in Oregon, but it is unevenly distributed with respect to location and timing. Major river systems drain the Coast Range, Cascades, Klamath, Blue, and Wallowa Mountains, and the terminal lake basins of the Great Basin. Each of these areas has a distinct topography and plant community, which interact with climate and geology to produce unique runoff patterns. Floods may occur every few years in the humid, western part of the state. Although less frequent, floods are not uncommon in the semiarid eastern region. Water shortages common to eastern Oregon can also occur in the western side of the state, especially during dry summers. Snow, and the timing of when it melts, plays a major role in shaping annual hydrographs.

The arrival of precipitation in Oregon, whether by rain or snow, stands in stark contrast to the months in which water demands are at their peak for most uses. The accompanying graph shown in Figure 1-2 demonstrates this mismatch in timing between supply and out-of-stream demand. The green line represents crop requirements that peak in demand during the months of June, July, and August. The red line represents municipal and domestic use that also peaks in the summer months. The blue line, by contrast, represents typical streamflow distribution in western Oregon, hitting a trough during those same summer months.

**Figure 1-2: Example of Streamflow vs. Demand**




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

## Surface Water Availability

The Oregon Water Resources Department has created and continues to maintain a database of the amount of surface water available for new appropriations for most waters in the state. This database is used to evaluate new water right applications. Most of the surface water resources in Oregon are fully allocated during the summer months.

**Figure 1-3: Available Streamflow in August**
(calculated at 80 percent exceedance)

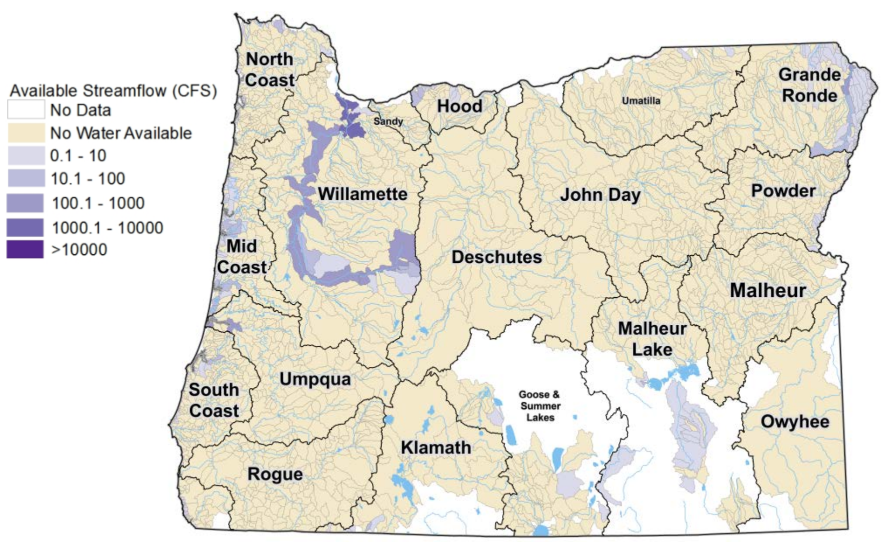
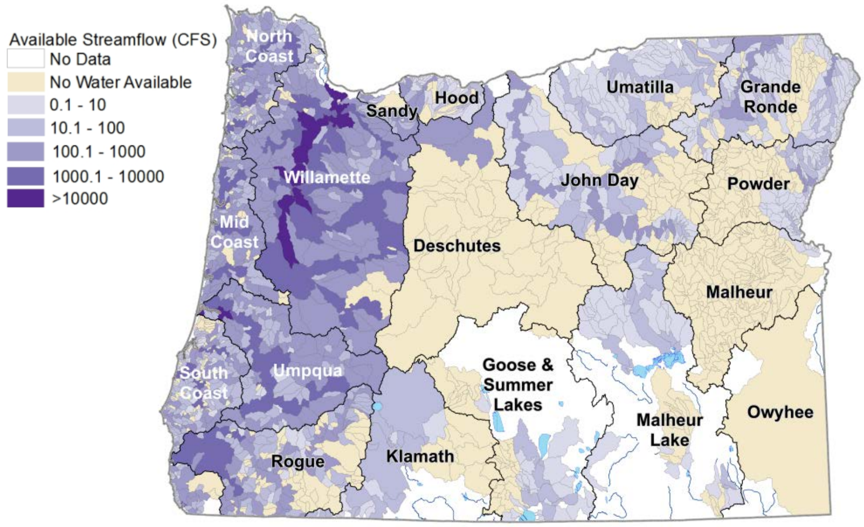



Figure 1-3 shows (in blue) where water is available for live flow allocation during the month of August, the month most representative of low summer flows and high out-of-stream demands. With some exceptions, the mostly-tan map indicates that throughout the state, very little surface water is available to allocate for new uses during August.

Increasingly, water users are relying on tools such as water conservation, reuse, water right transfers, and water storage to meet their needs during the summer months. Some of these tools are designed to benefit instream flow.

Some water is available during the winter months to allocate for new out-of-stream uses or protect instream uses. Figure 1-4 illustrates (in blue) water availability for new uses during the month of January. Many water users, with authorization, store available surface water during the winter and early spring to supplement their water supplies.

**Figure 1-4: Available Streamflow in January**
(calculated at 50 percent exceedance)

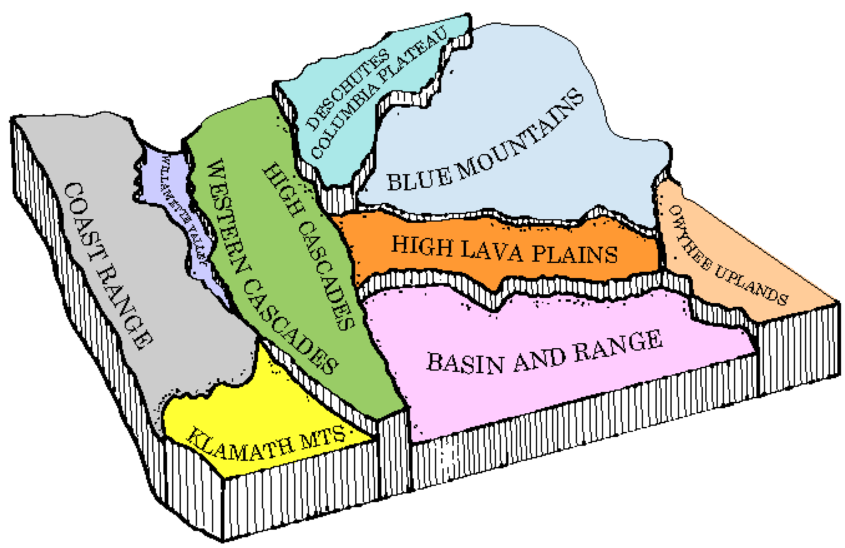



## Groundwater

Groundwater occurs almost everywhere beneath the land surface. However, the ability of rock and sediment to accept recharge and transmit groundwater varies greatly throughout the state based on hydrogeologic characteristics. Oregon's most productive regional aquifer systems occur in the Willamette Valley, High Cascades, and Deschutes-Columbia geologic provinces (Figure 1-5). However, productive local aquifers exist throughout the state and most geologic formations or rock types in Oregon are capable of producing at least small quantities of potable water suitable for domestic use.

Recharge to groundwater occurs from many sources, including rainfall, snowmelt, irrigation and other artificial systems. Water that has infiltrated to the groundwater system flows along subsurface pathways under the forces of gravity and pressure, and ultimately exits the groundwater system through discharge to surface water bodies, vegetation uptake, and appropriation through wells. Movement of groundwater is relatively slow (feet or less per year, as opposed to feet per second as surface water flow is commonly measured) and its residence time underground varies from days to millennia.

**Figure 1-5: Major Geologic Provinces of Oregon**

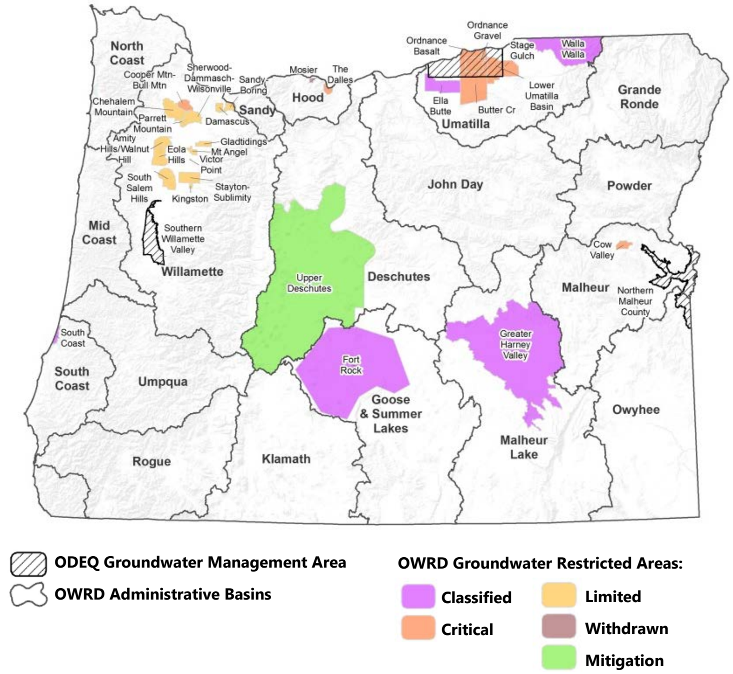


## Groundwater Availability

Groundwater development has occurred primarily in areas where the geologic conditions are favorable or where additional surface water is no longer available for new allocations.  In some locations, groundwater aquifers are no longer capable of sustaining additional development.  In the Willamette Valley, for example, 14 areas have been completely withdrawn from future uses or limited to a few uses, such as domestic use or fire protection.

The limitations of groundwater include groundwater quality, as some aquifers contain saline water, while others contain area-wide nitrate contamination, making the water unfit for human consumption.  Groundwater contamination is a serious issue in some locations in Oregon, affecting portions of Linn, Lane, and Benton Counties, the Lower Umatilla Basin, and northern portions of Malheur County.  Refer to Figure 1-6 for areas administratively designated, due to known groundwater issues.

**Figure 1-6:  Groundwater Administrative Areas**
(Quality & Quantity)




## Groundwater – Surface Water Interaction

Groundwater is connected to surface water, and because Oregon water law recognizes this important connection, the state manages these resources as one.  This is called conjunctive management.

The hydraulic connection of groundwater to surface water means that groundwater use can deplete streamflow. However, this depletion is often difficult to measure or is delayed in effect, making conjunctive management a challenge.

Generally, the Water Resources Department denies, limits, or requires mitigation for new groundwater applications in instances where use from an aquifer could substantially interfere with a surface water source that is already fully appropriated.  One example of conjunctive management stems from a 2001 study[2] conducted by the Water Resources Department and U.S. Geological Survey that quantified the hydraulic connection between groundwater and surface water within portions of the Deschutes River Basin.  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.

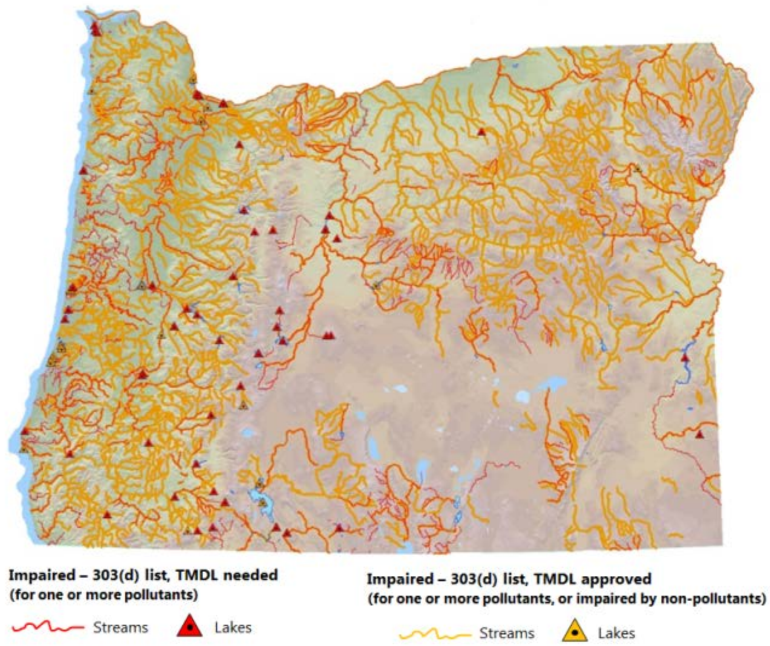
## Surface Water Quality

Temperature, sedimentation, and nutrients are the most common types of pollution 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.

Streamflow is a key factor in calculating pollution concentrations. Some pollutants, such as temperature, dissolved oxygen, and bacteria, are more likely to reach harmful levels when streamflow is low. Other pollutants, such as sediment, are more likely to reach harmful levels with high flows.

More than 1,530 water bodies are impaired and not meeting water quality standards, including more than 70 lakes and reservoirs, and about 24,500 stream miles. The accompanying map (see Figure 1-7), based on DEQ's 2010 Integrated Report for the Clean Water Act, 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. Oregon submitted its 2012 Integrated Report for approval to the U.S. Environmental Protection Agency in November 2014; it was partially approved in December 2016.

**Figure 1-7: Surface Water Quality**
Water Quality Limited Waters – 2010 Integrated Report




A TMDL is the calculated pollutant amount that a waterbody can receive and still meet water quality standards. Note that waters on the accompanying map are shown as needing a TMDL (in red) until all have been completed for that waterbody. In other words, some waterbodies are impaired by more than one pollutant and may need additional TMDLs completed.

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

## Groundwater Quality

Groundwater contamination is also a serious issue in some areas of Oregon. Private domestic wells may face contamination issues from nearby failing septic systems. Industry and agriculture can also be a source of pollutants for groundwater, as can surface water and groundwater interactions. In public water supplies, routine monitoring and ambient groundwater quality studies over the past 20 years have found that 35 of 45 study areas show some impairment or reason for concern.

Most of DEQ's groundwater monitoring efforts target vulnerable areas or areas of known contamination (i.e., Groundwater Management Areas (GWMAs)). Nitrate is one of the most commonly analyzed contaminants in these areas, with data showing that around 30 percent of groundwater samples detect nitrate at levels that suggest a pollution problem exists (7 mg/L), and around 20 percent currently exceed health standards (10 mg/L). Bacteria are a commonly detected contaminant as well, with about 20 percent of samples showing positive bacteria detections. Arsenic is not as commonly studied, but when sampled in vulnerable groundwater areas, about 30 percent of samples show levels above health standards (10 ug/L).

Other contaminants detected in groundwater studies include Dacthal, manganese, lead, iron, aluminum, perchlorate, uranium and vanadium. There have been few studies that investigate contaminants such as current use and legacy pesticides, herbicides, pharmaceuticals, personal care products and volatile organic compounds. Based on data collected in the past five years, when detections of those contaminants are found, they are often far below health standards, if any standards exist.

The Department of Environmental Quality conducts groundwater quality studies in new areas of the state each year, focusing on areas where groundwater may be especially vulnerable to contamination as well as areas where little data exists. The Department of Environmental Quality shares this information with local groundwater users to inform them about their drinking water quality and potential contamination risks.

## Ecosystem Health

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 can offer early warning signs of stress, such as disease or pollution.

Such indicator species include native salmonids (salmon, steelhead, and trout) that depend on cold, clean water. Since 1991, the National Oceanic and Atmospheric Administration's Fisheries Office of Protected Resources, which monitors anadromous species, has listed 15 out of 23 species of salmon and steelhead found in Oregon under the Endangered Species Act. To date none of them have been delisted.

In addition to these indicator species, the U.S. Fish and Wildlife Service has listed eight non-anadromous fish species. These are fish that reside year-round in Oregon's rivers and streams.

The high number of fish species listed as threatened or endangered is partially related to dwindling water quality and quantity in many areas of the state during critical life history periods and can be an indicator of inadequate ecosystem health. Recovery efforts by local, state, tribal, and federal entities are underway for these listed species, which include improving access to habitat, increasing habitat quantity, and improving habitat quality.

As a result of these efforts, the U.S. Fish and Wildlife Service announced the removal of the Oregon chub and Modoc sucker and their associated critical habitat from the list of Endangered and Threatened Species in 2015, making them the first to be delisted due to recovery. In addition, the status of two other Oregon species are also improving; Borax Lake Chub and the Foskett Spring Speckled Dace are proposed to be delisted or reclassified in the near future.

Improving freshwater ecosystem health provides benefits beyond those important to these indicator species. All Oregonians benefit from a healthy aquatic ecosystem and the services it provides as freshwater is vital to human life and economic well-being. Ecosystem services provide clean air, clean and abundant water, fish and wildlife habitat and other values that are generally considered public goods. Impacts to indicator species can serve as an early warning sign of broader impacts to the benefits that Oregonians enjoy as a result of natural processes and biological diversity.

# Critical Issue – Improve Water Quality and Water Quantity Information

Improving our knowledge of water resources requires investments in inter-agency work, analytical methods and approaches, scientific modeling tools, and platforms to share information with the public and other partners.

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 water monitoring programs.

Data-sharing among agencies supports informed decisions and more efficient management of water resources. As one example, the Department of Environmental Quality and Department of Fish and Wildlife provide information and advice to properly evaluate water allocation decisions made by the Water Resources Department. Their understanding of species and water quality needs helps determine whether a proposed use of water is in the public interest.

As another example, the Department of Forestry uses water right information from the Water Resources Department to determine whether forest streams are sources of domestic drinking water. Streams that serve as a drinking water source trigger more stringent forestry protections. There are many 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.

The state needs to maintain and add to its monitoring networks to augment its long-term record, fulfill its day-to-day management responsibilities, and identify changing trends. Installing and maintaining additional monitoring stations such as observation wells, streamflow gages, rain gages, snow survey equipment, soil moisture sensors, and AgriMet weather stations will need to be done in strategic locations, and will need to answer a growing list of questions. For many of these, monitoring stations will be more effective if they are paired, such as an observation well in tandem with a stream gage, or a snow survey measurement site with an observation well.

## Monitor and Evaluate Groundwater Levels

Accurate location information and water-level data are critical for assessing 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. Today, there are nearly 380 active state observation wells, in addition to about 500 project measurement wells in Oregon. Since 2013, the Oregon Legislature has provided funds to help expand the Water Resources Department's network of dedicated observation wells, providing staff with year-round access to make measurements. The process of siting these wells is spelled out in more detail in the Department's 2016 Monitoring Strategy.[3] Expanding the network of observation wells is often needed in basins where the state plans to pursue cooperative groundwater studies in partnership with the U.S. Geological Survey.

### Conduct Groundwater Basin Studies

Oregon has a need for additional basin studies 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 cooperative, cost-share programs. These investigations result in a conceptual model of the basin, including a description of the geology of the basin and a water budget, showing overall volumes of groundwater recharge, discharge, and dynamic storage. A numerical groundwater flow model is also developed and used to better understand the outcome of potential management scenarios.

The Water Resources Department has completed cooperative basin studies in three areas (Deschutes, Willamette, and Klamath) and is currently working with the U.S. Geological Survey to study the Harney Basin. The state has prioritized additional basins for subsequent groundwater studies. Priority areas include:

- The Umatilla Basin's Walla Walla Sub-Basin, where senior basalt groundwater users are not receiving their usual and customary amount of water.
- The Umatilla Basin's Lower Umatilla Sub-Basin, where senior surface water users are asking the Department for help in addressing the cumulative impacts of alluvial and shallow basalt groundwater development.
- The Hood Basin's Fifteen Mile Creek, where there are declining groundwater levels and indications that groundwater extraction is affecting surface water flow.
- The Grande Ronde Basin, where residents have asked the Department to identify potentially available groundwater and to describe potential over-allocation.
- The Powder Basin, where the county and community have asked the Department to identify potentially available groundwater and to describe potential over-allocation.

### Evaluate Groundwater Administrative Areas

The Water Resources Department oversees more than 20 groundwater administrative areas, which include limited or "classified" areas, critical areas, and withdrawn areas, designated to prevent further water level declines.

Groundwater limited areas contain a number of five-year groundwater permits. These permits are scheduled to expire at different times. It would be more efficient to review these time-limited permits at the same time, providing more consistent reviews for well owners and making better use of the reviewers' time.

Groundwater administrative 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. Some previously designated areas may need to have designations changed or borders adjusted. In addition, the state needs to dedicate resources to determine whether additional areas require groundwater designations, and if so, to what degree. Such areas could include portions of the Umatilla, Hood, Willamette, Deschutes, and Klamath Basins.

**Recommended Action 1.A**
**Conduct Additional Groundwater Investigations**

Examples of how to implement this action:

- Install and maintain dedicated state observation wells in priority basins
- Partner with U.S. Geological Survey to conduct and cost-share additional groundwater recharge studies and basin investigations
- Evaluate groundwater administrative areas; review time-limited permits more efficiently
- Locate and document water wells, including exempt use wells, permitted wells, and unused wells
- Ensure high-quality groundwater level measurements; install measuring tubes and make scheduled measurements

### Improve Groundwater-Related Records

Well owners, consultants, and agencies need better information about Oregon's water wells, some examples are described below.

**Water Well Location Information –** Oregon currently has inadequate documentation of the number, location, and average water use of water wells. Wells were not required to be registered with the state until 1955. Since then, most well location information has been reported 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 exempt-use wells, which are most often used for domestic purposes. An estimated 230,000 such wells exist today, with several thousand more drilled each year. In 2014, the state updated its online mapping program to help well drillers and landowners record the location of new, existing, and unused water wells—including both exempt-use wells and permitted wells.

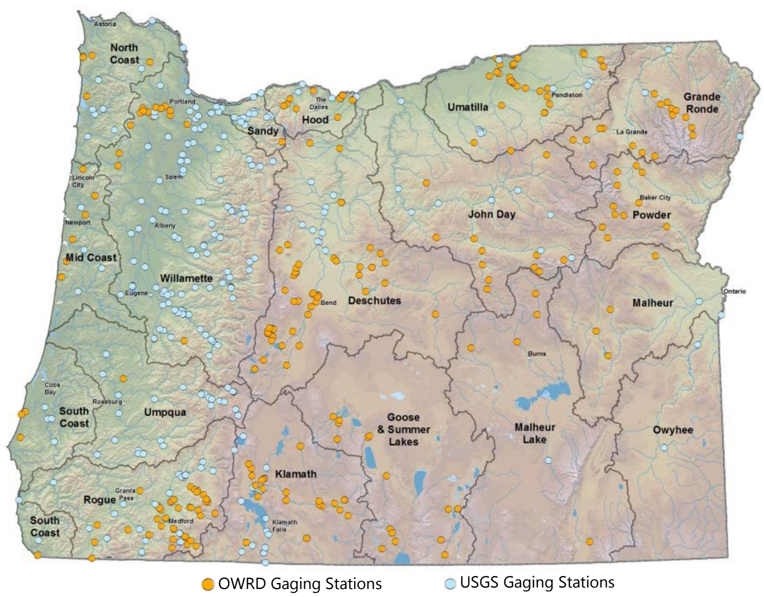
**Water-Level Access –** Measuring tubes help to ensure that accurate measurements or samples can be taken in water wells, without getting tangled in pumps or wires. Several locations in Oregon, such as Eola Hills in Polk County, Pete's Mountain in Clackamas County, and Mosier in Wasco County have requirements to install measuring tubes during new well construction.

**Scheduled Measurements –** Agency scientists collect baseline information at the start of each irrigation season, before any significant groundwater pumping begins. This activity is a high priority because it contributes to Oregon's long-term understanding of the resource. If measurements are not taken each spring, opportunity for measurement—and therefore good information—is lost.

## Monitor and Evaluate Surface Water Flows

The Water Resources Department operates more than 250 stream and reservoir gages throughout the state, maintaining an extensive long-term record for many of them. This network of gages informs water planning, permitting, and management decisions. About 200 of these gages are operated as near real-time, and transmit data once every hour. It is the state's intent to continue to grow and maintain this network. Since 2013, the Oregon Legislature has dedicated funds to help expand and maintain the state's stream gaging network. The Department also provides access to data from an additional 345 gages, primarily from the U.S. Geological Survey (USGS).

**Figure 1-8: Active Surface Water Gaging Stations**




Operating a stream gage network requires trained hydrographic technicians to keep the equipment operating properly, to conduct regular measurements at various stream gages, 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.

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 Department of Environmental Quality (DEQ), for example, uses streamflow data to calculate the loading capacity of certain pollutants during development of TMDL plans to improve water quality.

Currently, the state lacks sufficient capacity to maintain and process data from its network of stream gages in a timely fashion. This has resulted in a backlog of unprocessed records and has hindered the Department's ability to share valuable water resources information. The public can access these records in their provisional state, but not in final form.

## Monitor and Evaluate Groundwater Quality

During the past few decades, dwindling budget resources and other water quality priorities have significantly decreased groundwater quality protection efforts. In the early 1990s, DEQ had 12 staff dedicated to the groundwater quality program. By the early 2000s, program staff had decreased to five. The groundwater program only consisted of technical assistance, minimal statewide coordination, and implementation of groundwater monitoring and restoration activities in three designated Groundwater Management Areas (GWMAs) — Northern Malheur County, the Lower Umatilla Basin, and the Southern Willamette Valley.

To obtain a more comprehensive understanding of the water quality conditions of groundwater resources outside of the GWMAs, the 2013 Oregon Legislature provided funds for DEQ to implement a Statewide Groundwater Monitoring Program. It was designed to monitor groundwater for contaminants of concern, including nitrates and pesticides, in two geographic regions per year. The data and information developed will be used to determine: areas of the state that are especially vulnerable to groundwater contamination; long term trends in groundwater quality; status of ambient groundwater quality; emerging groundwater quality problems; and potential risks from contamination.

In 2015, DEQ conducted its first groundwater quality study under its statewide program in the mid-Rogue River Basin, sampling approximately 100 domestic wells over two sampling events in the spring and fall. Similar studies in the North Coast basins of Clatsop and Tillamook counties and the Walla Walla River Basin in Umatilla County followed. In 2017, sampling took place in the Mid-Willamette Valley surrounding Salem; DEQ is making plans for a 2018 study. DEQ is collecting high-quality data on nitrate, arsenic, coliform bacteria, pesticides, as well as pharmaceuticals and other select contaminants based on local risk factors and program capacity. By 2018, approximately 370 wells will have been tested under this program.

DEQ identifies areas of groundwater contamination, as well as potential health risks from the contaminated groundwater, informing each user of this risk and providing educational and technical resources to address those risks. For each study area, DEQ provides a brief data summary and technical report, along with a public presentation of results. Currently, resources are not available for an in-depth analysis of the results, but the data are available for the public and outside organizations to use to support local programs and outreach activities.

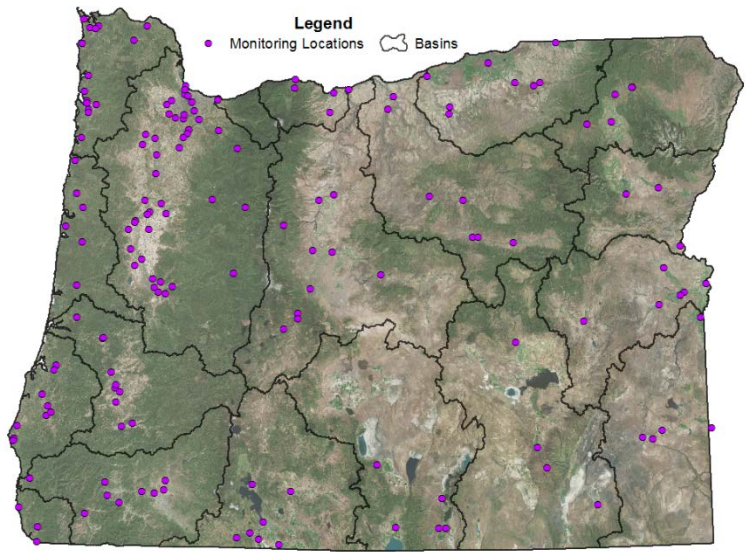
With continued funding, DEQ plans to rotate to new study areas around the state and will be working closely with local organizations and interested participants. Continuation of this type of collaborative and widespread monitoring will help fill in data gaps and begin to identify long-term trends in groundwater quality.

**Testing Water Quality in Private Drinking Water Wells –** Private drinking water supply wells are not routinely tested for water quality issues, 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. The data provides a broad overview of groundwater quality in the state. Most domestic well tests (88 percent) show nitrate levels below 3 milligrams/liter (mg/L), reflecting background groundwater quality. Approximately 12 percent of the tests show nitrate levels above background groundwater quality. About 1.6 percent of the wells tested exceeded the federal drinking water standard of 10 mg/L. Regarding arsenic, 63 percent of tests did not detect any while 10 percent of the tests detected arsenic at levels above EPA's Safe Drinking Water Standard (SDWS) of 10 micrograms/liter (ug/L).

## Monitor and Evaluate Surface Water Quality

Water quality standards are established by the state to ensure that our lakes and streams support multiple beneficial uses, including protection of public health, recreational activity, and aquatic life. Water quality monitoring data and information on status and trends defines the priorities and sets the direction for programs and activities aimed at protecting and restoring water quality. State agencies and partners utilize water quality monitoring data to update water quality standards, determine causes of impairment, develop water quality improvement plans (Total Maximum Daily Loads), establish permit limits, notify the public of health advisories, measure project and program effectiveness and modify program strategies as needed to improve water quality outcomes.

**Figure 1-9: Ambient Water Quality Monitoring Stations**
November 2017




The Department of Environmental Quality monitors and evaluates water quality through a variety of programs that provide information on Oregon's waterbodies. Some of these activities are statewide assessments of water quality, whereas others focus on geographically-specific assessments of water quality or narrow categories of pollutants and/or beneficial uses. Established monitoring programs and projects include:

- Ambient monitoring network and Oregon Water Quality Index (OWQI)
- Watershed monitoring (TMDLs)
- Toxics monitoring
- Biomonitoring
- Oregon Beach Monitoring Program
- Volunteer water quality monitoring
- Groundwater monitoring
- National aquatic resource surveys
- Drinking water protection
- Other special projects

Although the state has several monitoring programs, the geographic scope and frequency of data collection and analysis is limited due to resource constraints. Water quality data is not available for all waterbodies and all pollution types, and therefore the assessment is not comprehensive. With more resources for monitoring and data analysis, more impaired waterbodies may be identified and begin the process towards meeting Oregon's water quality standards for the protection of public health and aquatic life. Monitoring data are also pivotal for ensuring that water quality improvement strategies and investments are cost-effective and achieve the desired results.

## Monitor and Evaluate Habitat Conditions and Watershed Functions

The Oregon 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 the change in river channels over time, 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.

The Oregon Watershed Enhancement Board keeps a restoration inventory of more than 17,000 completed projects 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.

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

Examples of how to implement this action:

- Use agencies' monitoring strategies, or similar methods, to design, expand, and maintain real-time monitoring networks
- Prioritize basins for data collection and monitoring
- Establish quality assurance procedures to verify the accuracy of water use and other data
- Improve agency capacity to collect and analyze data, bringing records to final form
- Implement an on-going state-wide groundwater quality monitoring program
- Update water quality standards and develop additional TMDLs
- Increase the number of stream gages with reportable water temperature data to support water quality programs
- Help homeowners test water quality in private drinking water wells; update real estate transaction database
- Monitor habitat and watershed conditions and evaluate the effectiveness of restoration efforts

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 essential to ensure effective and efficient restoration. The Department of Fish and Wildlife, for example, plans to update streamflow priority restoration areas using new species distribution and climate change information.

Recognizing that further investments in monitoring are needed and given the limited funding and staffing resources, Oregon is in the process of creating guidance for prioritizing watersheds/basins for data collection and monitoring. There are some watershed-based tools available today to prioritize sensitive water bodies and habitat for future restoration efforts. These include Endangered Species Act Recovery Plans, the Department of Fish and Wildlife's Oregon Conservation Strategy, watershed assessments and action plans, along with tools from the Department of State Lands, such as the Oregon rapid wetland assessment protocol, the stream functional assessment method, and streamflow duration assessment method.

# Critical Issue – Further Understand Our Water Management Institutions

No agency has sole jurisdiction when it comes to water management. In Oregon, water belongs to the public, and there are many public and private organizations with specific responsibilities and authorities related to the management of water resources. These organizations reside at the local, state, federal, and tribal level and each has a different mission, funding base, and constituency.

Stakeholders have expressed frustration over the difficulty agencies have coordinating policies, reconciling sometimes different missions, and gaining much-needed efficiencies. Although the Strategy contains many necessary recommended actions, it remains difficult to coordinate and strengthen connections between and among them because of the numerous agencies involved. Decision-makers must recognize that making these connections takes additional time, staff, and resources on the part of agencies and their partners.

Such connections include groundwater and surface water interactions, supply and demand analyses, instream and out-of-stream uses, water quality and water quantity challenges, and land-use and water management. The opportunity to focus on these connections may come during future budget and policy discussions, local initiatives, permitting, or collaborative efforts, such as place-based planning.

The 2017 Strategy recognizes the importance of Oregon's legal, scientific, and institutional foundation and commits to continuing and strengthening it. Oregon has set the standard among states in several areas of water resources policy and innovation.

## How Water Quantity is Managed

### Doctrine of Prior Appropriation

Since 1909, Oregon's Water Code has created a system of water allocation and distribution throughout the state. With few exceptions, water 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 state authorization, although some uses are exempt from permitting requirements. 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. For more details, read *Water Rights in Oregon: An Introduction to Oregon's Water Laws.*[4]

### Permits

The Water Resources Department administers almost 90,000 water rights, which includes both permits and certificates, for both instream and out-of-stream uses, and on a daily basis it evaluates applications for new water use permits and changes to existing rights. Unlike the interconnected relationship the Oregon Department of Environmental Quality and Oregon Health Authority have with the U.S. Environmental Protection Agency, there is no federal agency counterpart that oversees the functions performed by the Water Resources Department.

In 1989, the Water Resources Commission directed the Water Resources Department to develop an allocation policy and establish a water availability program. A decision support tool was developed using on a historic hydrologic record to help evaluate whether new water use applications would be able to utilize surface water at least 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 and diminish surface water flows. When Oregon evaluates new requests for out-of-stream uses, it takes into account various factors, such as the needs of existing users, including established instream protections, as well as potential impacts to sensitive, threatened, or endangered fish species.

# Timeline of Water Resources Management

Many of the laws, plans, and policies noted in the following timeline represent major achievements and serve as a strong foundation for economic development, environmental restoration, and protection of human health in Oregon.

**1889** Oregon enacts a state law prohibiting pollution of waters used for domestic or livestock purposes

**1898** Oregon's first fish screening law protects fish from injury or mortality in diversion ditches, machinery, or irrigated fields

**1909** Oregon Water Code creates a system of water allocation and distribution

**1927** Oregon Legislature establishes requirements for obtaining water rights for the use of groundwater in eastern Oregon

**1929** Oregon Legislature establishes current dam safety laws

**1955** Oregon's Ground Water Act authorizes the state's management of groundwater resources statewide

**1955** Oregon's Minimum Perennial Streamflow Act creates minimum flow requirements to support fish and aquatic life or minimize pollution

**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

**1967** Oregon's Removal-Fill Law, established in 1967 and amended in 1971, requires landowners who plan to remove or fill materials in wetlands or waterways to obtain a permit from the Department of State Lands

**1970** Oregon Scenic Waterways Act maintains the free-flowing character of designated rivers and lakes in order 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

**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 land use plans

**1974** Federal Safe Drinking Water Act, later amended in 1996, regulates the quality of drinking water delivered through community water systems

**1987** Oregon's Instream Water Right Act recognizes water instream as a beneficial use and authorizes instream water rights

**1989** Oregon's Groundwater Quality Protection Act is passed to conserve, restore, and maintain the high quality of Oregon's groundwater

**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** Oregon's 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 needs for fish

**2001** Oregon's State Tribal Government-to-Government Law passed, directing state agencies to include tribes in the development of programs

**2005** The Deschutes Groundwater Mitigation Program was developed to provide for new groundwater uses while maintaining scenic waterway and instream water right flows in the Deschutes Basin

**2006** The Oregon Conservation Strategy provides an 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 involving natural resources

**2008** Oregon Legislature authorizes a grant funding program for feasibility studies of water storage, reuse, and conservation projects

**2009** Oregon Legislature establishes an Ecosystem Services Policy, focusing on the protection of land, water, air, soil, and native flora and fauna

**2010** The Environmental Quality Commission revises water quality and human health standards based on a Fish Consumption Rate of 175 grams per day per person—the most protective criteria in the nation

**2011** The Environmental Quality Commission approved rules allowing the issuance of Graywater Permits to reduce demand on other sources, such as potable water, surface water and groundwater

**2012** Oregon adopts its first Integrated Water Resources Strategy, a blueprint for meeting the state's instream and out-of-stream needs

**2013** Oregon delivers the Klamath Adjudication Findings of Fact and Order of Determination to Klamath County Circuit Court

**2013** Oregon Legislature authorizes a Water Supply Development Account, funding the implementation of water resources development projects

**2015** The Oregon Chub and Modoc Sucker are the first and only de-listings of fish species under the Endangered Species Act

**2015** The Oregon Legislature provides initial funding for Place-Based Integrated Water Resources Planning

**2017** The Oregon Environmental Quality Commission designates the North Fork of the Smith River as Oregon's first Outstanding Resource Water

## How Water Quality is Protected

### The Clean Water Act

The primary regulatory tool used to reduce or prevent pollutants from entering surface waters is the Federal Clean Water Act, which requires states to establish water quality standards to protect all beneficial uses of water. Indian tribes also have authority under the Clean Water Act to adopt and implement water quality standards within reservations. In Oregon, the Department of Environmental Quality (DEQ) administers the Clean Water Act with oversight from the U.S. Environmental Protection Agency.

According to the Clean Water Act, each state must assess the quality of water bodies across the state. The state must then develop Total Maximum Daily Loads (TMDLs) and implementation plans for all waterbodies that do not meet the state's water quality standards. Certain federal, state, and local governments and agencies, including cities, counties, and special districts become Designated Management Agencies with authority to manage and regulate water pollution resulting from many different sources that are listed in the TMDL.

### Permits

To regulate the discharge of pollutants from point sources (e.g., the pipe of an industrial facility or wastewater treatment plant), Oregon DEQ issues National Pollutant Discharge Elimination System (NPDES) permits. DEQ also issues Water Pollution Control Facility (WPCF) permits to regulate the point source discharge of wastewater onto land. Both of these permits limit the amount of pollution that can be discharged and require that specific practices be followed to protect surface waters and groundwater aquifers. Permittees are required to monitor and report discharges to DEQ, which then reviews these reports and conducts site inspections to ensure that permittees comply with the requirements.

Oregon DEQ also reviews new water right applications, offering guidance on whether the proposed use complies with existing state and federal water quality standards.

For livestock operations, the Oregon Department of Agriculture is the lead agency responsible for issuing Confined Animal Feeding Operation (CAFO) permits to owners so manure does not pollute ground and surface water.

### Other Relevant Water Quality Laws

In 1993, the Oregon legislature passed the Agricultural Water Quality Management Act, enabling the Oregon Department of Agriculture to develop plans and rules to prevent and control water pollution from agricultural activities in order to achieve water quality standards. The Act is part of the state's effort to address the federal Clean Water Act and it serves as the foundation for the state's Agricultural Water Quality Program, ensuring that farmers and ranchers do their part in meeting water quality standards. There are 38 Agricultural Water Quality Management Area Plans and Rules around the state. Water quality specialists with the Department of Agriculture work with farmers, ranchers, community leaders, and other stakeholders who serve as members of local advisory committees for each management area. Each committee identifies local agricultural water quality problems and opportunities for improvement.

The Oregon Legislature passed the Forest Practices Act in 1971, the first law of its kind in the United States at that time. The Act and its rules have been changed many times in response to new scientific findings and evolving public needs and interests. The Forest Practices Act sets standards for all commercial activities involving the establishment, management, or harvesting of trees on forestlands. Many of the rules are aimed at protecting water sources. For example, regulations require landowners to leave forested buffers and other vegetation along streams, wetlands, and lakes to protect water quality and fish and wildlife habitat. The Oregon Board of Forestry has primary responsibility to interpret the Act and to set rules for forest practices. The forestry laws have created a partnership between the Department for Forestry, landowners, and operators to achieve efficient and effective resource protection. Department policy, carried out on the ground by stewardship foresters, ensures compliance through a balance of science-based rules, incentives, educational and technical assistance, and uniform enforcement.

The Groundwater Quality Protection Act was adopted in 1989 in recognition of the need to prevent contamination of groundwater resources, to conserve and restore the resource, and to maintain the high quality of Oregon's groundwater resources for present and future uses. All state agencies' rules and programs must be consistent with the goal of protecting drinking water resources and public health. The Department of Environmental Quality has primary responsibility for implementing groundwater protection in Oregon and uses a combination of water quality and land use programs to implement the Act. Other state agencies also play a role in groundwater management and protection.

## How Ecosystems Are Protected

### The Endangered Species Act

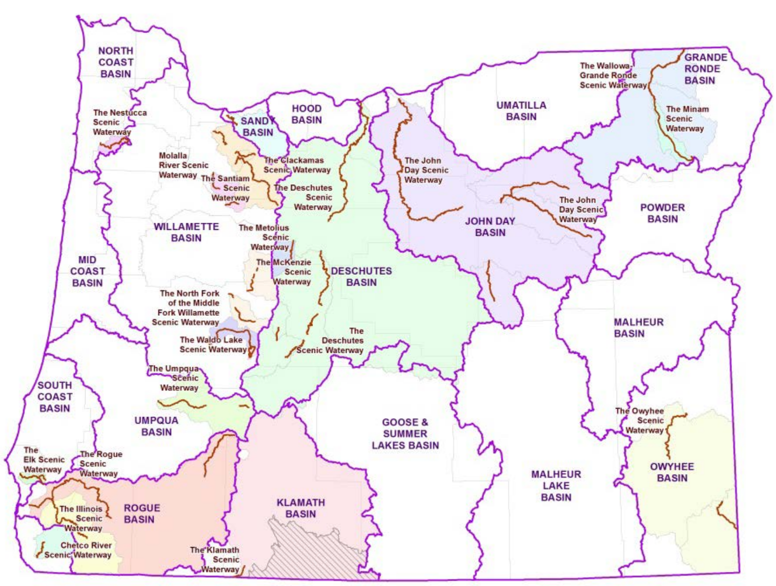
The purpose of the federal Endangered Species Act (ESA) is to protect and recover endangered or threatened species and the ecosystems upon which they depend. "Endangered" means a species is in danger of extinction throughout all or a significant portion of its range. "Threatened" means a species is likely to become endangered within the foreseeable future. This law is administered by the U.S. Fish and Wildlife Service and the 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.

Led by the Department of Fish and Wildlife, Oregon participates in the development of recovery plans for its ESA-listed fish species. These plans provide an informed, strategic approach to recovery that is based on science and supported by stakeholders. They allow for adaptive management over time as new information is acquired. Coordinated action with citizens, and other local, state and federal agencies is essential for successful implementation.

### Oregon's Scenic Waterways Act

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 Waterways Act has created one of the most extensive scenic waterway systems in the country, with more than 1,100 river miles protected. 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.

**Figure 1-10: State Scenic Waterways and Contributing Areas**

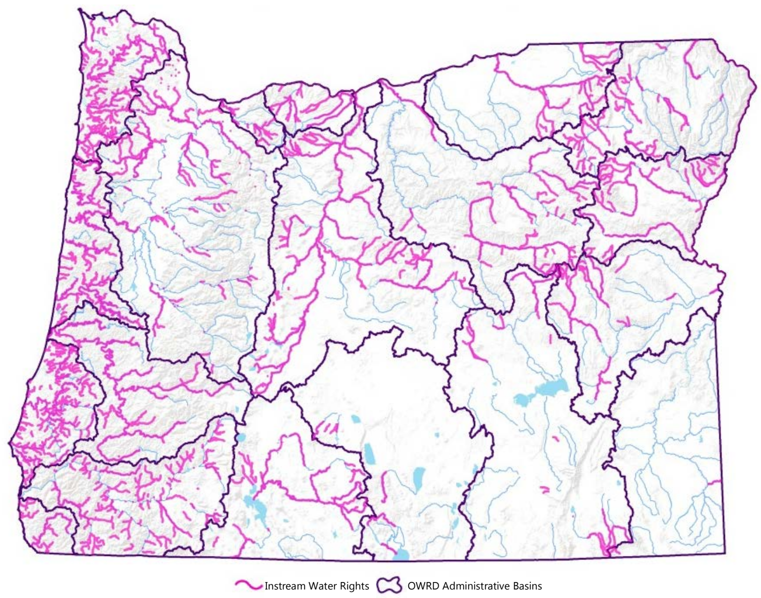



The Scenic Waterways Act specifically prohibits construction of dams or other impoundments within a scenic waterway. It limits new surface water rights within or above scenic waterways. It also limits new groundwater rights, if groundwater pumping (individually or cumulatively) will measurably reduce 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 consults with several natural resources agencies, including the Water Resources Department.

## Oregon's Instream Water Right Act

Oregon's 1987 Instream Water Right Act was designed to protect instream flows by establishing instream water rights. The Department of Fish and Wildlife, Parks and Recreation Department, and Department of Environmental Quality can submit applications to protect water instream. More than 900 instream rights have been established through this process, and are 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 for in the same way as other out-of-stream water rights, though many of them are junior to out-of-stream uses. Junior instream water rights are generally not being met, particularly in the summer months, but do establish flow targets necessary to set basic protections for aquatic life.

**Figure 1-11: Instream Water Rights**




Even as far back as the 1950s, Oregon put streamflow protections in place to support aquatic life and protect water quality. The state has converted more than 500 of these older protections, called "minimum perennial streamflows," into instream water rights.

Since adoption of Oregon's Integrated Water Resources Strategy in 2012, the Department of Fish and Wildlife has been working to prepare additional instream water right applications to help achieve the state's instream goals. The first applications were submitted to the Water Resources Department in 2016.

## Fish Screening & Passage Laws

Oregon established its first fish screening laws more than 100 years ago. Screens prevent fish from being caught in water diversion structures. Further, in locations where native migratory fish are currently or have historically been present, fish passage over man-made dams and diversions has also been a requirement since before statehood. Today, the state requires 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.

## No-Net Loss Wetland Policy

Although Oregon's wetland management and protection authorities 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 (coastal) wetlands, administered by the Department of Land Conservation and Development.

## How Public Health Is Protected

The 1974 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 Safe Drinking Water Act requires the U.S. Environmental Protection Agency to establish and enforce standards that public drinking water systems must follow. The EPA delegates primary enforcement responsibility (called primacy) to state and tribal governments, with certain requirements.

### Is it Safe to Drink?

The Safe Drinking Water Act was amended in 1986 and 1996. The Act and these amendments created a coordinated set of programs and requirements to help water system operators make sure communities have a safe supply of drinking 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. More than 3,400 public water systems serve 89 percent of Oregon's population, or about 3.4 million people. Oregon's public water systems are fed by more than 200 surface water diversions, nearly 4,000 groundwater wells, and 225 springs. Each year, drinking water providers must report to their customers the results of mandatory water quality testing they perform on their potable water supplies.

**Addressing the Causes of Waterborne Diseases –** In the 1970s, Oregon experienced 15 waterborne disease outbreaks, including events at Crater Lake National Park in southern Oregon and Government Camp on Mt. Hood. Events such as these illustrated the need for rigorous national drinking water standards.

Although Oregon initially declined sole responsibility, or "primacy," for the 1974 Safe Drinking Water Act, the state did establish its own program in the early 1980s. The program operated in tandem with the U.S. Environmental Protection Agency until Oregon assumed primacy in 1986.

Oregon focused on the continuing community waterborne disease problem, whose root cause was the use of unfiltered surface water sources from forested mountain watersheds. Although crystal clear, these sources contained environmental pathogens, especially Giardia. Fifty-five Oregon communities with unfiltered surface water sources installed treatment, connected to others, or drilled wells because of the 1975 EPA turbidity standard (i.e., cloudiness of water).

An additional 161 water systems with unfiltered surface water or groundwater sources (under the influence of surface water) made improvements due to treatment requirements established under the 1986 amendments. Only a few unfiltered communities in Oregon qualified for filtration exceptions and are now required to make improvements to meet cryptosporidium treatment requirements established under the 1996 amendments.

Even today, water systems can experience difficulties with waterborne diseases. Baker City, for example, uses an unfiltered surface water supply and experienced a cryptosporidium outbreak in 2016, and the City of Portland took its unfiltered Bull Run water supply temporarily off-line in early 2017 due to cryptosporidium detections as well. In May 2017, the Oregon Health Authority notified Portland that it would have to begin treating Bull Run water for cryptosporidium, and in August 2017, the city council voted to pursue filtration as the preferred treatment option.

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.

**Most Common Contaminants in Public Drinking Water —** In Oregon public water systems, the most commonly found contaminants are arsenic, disinfection by-products, lead, copper, and nitrate. Arsenic is usually naturally occurring due to the volcanic nature of the state's geology. Small levels of nitrate can also be naturally occurring; however, higher levels are often due to the influence of human or animal waste or fertilizers. The Oregon Health Authority requires public water systems to notify their customers in the event of high levels of contaminants, and to apply treatment or use an alternate source.

The presence of lead in drinking water has garnered national attention in recent years. The unsafe lead levels found in Flint, Michigan's public water system in 2014 ultimately led to the EPA issuing an emergency order to protect public health and make sure the public has access to testing and sampling results.[5]

Fortunately, few of Oregon's public water distribution systems contain lead components. However, lead can leach from home or building plumbing into the water. Some water providers treat their source water to reduce corrosivity and thus, lead at the tap. In August 2016, the Oregon Board of Education adopted new rules mandating that school districts and public charter schools submit a plan to test for lead and communicate the findings.[6] More information on reducing lead exposure can be found at healthoregon.org/lead.

## Is It Safe to Swim?

While generally it is considered safe to swim in Oregon's lakes and streams, each waterbody has a unique watershed and pollutants can reach the water from many potential sources.

Exposure to bacteria is the greatest health concern for people swimming or wading in lakes, streams, and coastal waters. Ingesting bacteria can cause gastrointestinal illness. Bacteria can wash into the water following heavy rains from various sources including overland flow from agricultural areas, stormwater discharges from urban areas, and sanitary sewer overflow events. When washed into warm stagnant waterbodies, bacteria multiply faster than they die off resulting in increased concentrations. Several agencies are responsible for monitoring and regulating potential sources of bacteria to ensure Oregon's waters are safe for recreational activities. For example, DEQ regulates wastewater discharges and urban stormwater discharges, ODA regulates bacteria sources on agricultural lands, and OHA and DEQ work together to monitor bacteria levels in coastal areas.

Harmful algal blooms (HABs) are another health risk to swimmers and waders. Most often harmful algal blooms in freshwaters are caused by cyanobacteria, which are not actually algae, but a type of photosynthetic bacteria. More information on HABs can be found in Chapter 4.

## Is It Safe to Eat the Fish?

There are some pollutants in Oregon's waterbodies that are found at levels too low to be a concern when swimming or wading. Yet, fish and other aquatic life can bioaccumulate the pollutants in their flesh and become a health risk for people that eat them. Examples of these pollutants include metals, pesticides, pharmaceuticals, polychlorinated biphenyls (PCBs-now banned), dioxins/furans, and polycyclic aromatic hydrocarbons.

**Mercury, An Example –** Mercury is a naturally occurring element that is found in air, water, and soil and exists in several different forms. Methylmercury is the organic form of mercury that most easily enters the body. It can be naturally formed in the soil or water by certain types of bacteria. A number of factors influence the formation of methylmercury. For example, methylmercury is more likely to form in a water body where there is a high amount of organic material or where algal blooms are prone to occur. Methylmercury increases in concentration as it moves up the food chain and is the form of mercury most toxic to humans. Because methylmercury bioaccumulates, consuming fish is the most common way people become exposed to mercury.

Oregon DEQ, in conjunction with its partner agencies, collects fish tissue samples from Oregon waters to monitor the level of mercury in fish. Results of these analyses indicate that some resident fish from rivers and lakes throughout the state have levels of mercury in fish tissue higher than the state methylmercury standard of 0.040 mg/kg. Northern pikeminnow and bass are commonly sampled fish and live as predators or bottom-feeders. Therefore, these fish tend to have higher levels of mercury in their tissue. Non-resident fish, such as salmon and steelhead have not been included in DEQ studies because they spend limited time feeding in Oregon rivers or lakes and generally contain lower levels of mercury. Sampling fish for mercury and other toxics is an important part of DEQ's monitoring strategy and it will continue to be part of its long-term toxics monitoring program.

## Enhance Data Coordination

Monitoring Oregon's waterways is not limited to just state agencies. There are several federal agencies whose data collection and analysis are critical to the understanding and management of Oregon's surface water and groundwater resources. The Natural Resources Conservation Service, the National Weather Service, and the United States Geological Survey are three such agencies. Three additional federal agencies, the Army Corps of Engineers, Bureau of Reclamation, and the Bonneville Power Administration are key partners in the operation and management of key pieces of water infrastructure, including reservoirs used for power production, irrigation, and flood control.

Several years' worth of water quantity and quality data still needs to be processed, analyzed, and shared with the public and other partners. Methods to enhance data collection, processing and sharing include:

- Coordination – Better integrating federal, state, and local data collection efforts, while adhering to quality control standards
- Training – Improving data collection standards, manuals, training, and technical support
- Access – Providing on-line platforms for data submittal and quality control
- Real-Time – Adding remote and real-time monitoring to existing stations
- Backlogs – Processing the backlog of water quantity and water quality 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 presents a significant, ongoing challenge.

### Make Water-Related Information Available Electronically

Water-related program information, contact information, and data are often not available from state agencies, or sometimes difficult to find and use. Agencies try to keep fact sheets and how-to-guides accurate and up-to-date. 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 entering backlogged information and making it available.

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 data more interactive. Agencies at all levels of government need to upgrade websites, file transfer protocol or "FTP" sites, and other electronic means to make water-related information readily available and usable. The Water Resources Department has a number of web services accessible to the public, such as water rights, well logs, and streamflow data. In just one year—from July 2016 to June 2017—streamflow data from the Department's online database was accessed more than 287,000 times.

Students and stakeholders have asked whether they could write applications supported by hand-held devices, repackaging agency information for public use. In an era of crowd sourcing and open source code, this is an example of open standards (i.e., providing the public access to agency data for use on multiple platforms). Supporting such efforts can extend the reach and use of agency information more quickly than agencies can deliver on their own.

**Highlight Box**

**Community Led Water Quality Testing**

There's no question that Oregonians like to play on the beach. Recreational opportunities on our beaches attract tourists to coastal communities. Clean water supports healthy beaches, healthy communities, and a healthy economy and that's why Surfrider Foundation is using citizen science to identify water quality issues on Oregon's beaches and work collaboratively towards solutions.

Surfrider's Blue Water Task Force Program currently operates 7 different labs in Oregon and regularly monitors water quality at nearly 40 different sites along the coast. These efforts are solely funded through local chapter fundraising efforts and operate through partnerships with schools, aquariums, watershed councils, and non-governmental organizations. This 100 percent volunteer run program tests water quality at popular beaches and five marine reserves year round, supplementing the state's Beach Monitoring Program, which only tests during the summer months.

Trained lab volunteers and youth help run the analysis of the samples in the lab, incubating them for 24 hours and posting the results the following day on the National Blue Water Task Force site and sharing information through social media, newsletters, and local media. This allows members of the public to get regular updates on the health of Oregon's beaches and know whether beaches are safe for recreation.

"Surfrider worked with us to chase down some tricky water quality issues on our beaches and helped us figure out solutions. Thanks to their efforts we now have a strong partnership and work together to make measureable improvements in beach water quality."
Tim Gross, City of Newport

Find more information at: http://www.surfrider.org/blue-water-task-force.

## Develop Decision-Support Tools

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

The state needs to invest in the tools and science needed for developing and testing future scenarios. Developed transparently and at the appropriate local scale, such scenarios can become powerful tools for decision-making and help prioritize investments in water resources projects, including economic development, flow, and habitat restoration efforts

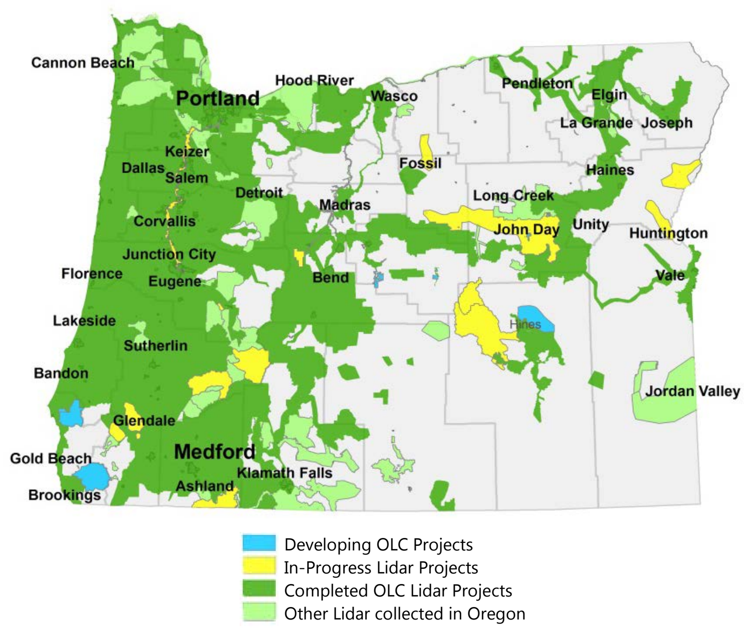
Various decision-support tools are described in more detail throughout this document and include: the Water Availability Reporting System, a Drought Early Warning System, Mapping Evapo-Transpiration using high Resolution and Internalized Calibration (METRIC), groundwater recharge studies and groundwater basin studies, instream flow studies, water quality monitoring programs, floodplain restoration programs, and precipitation/flood forecasting tools. These existing modeling and other decision-support tools need to be periodically updated.

For instance, the Water Availability Reporting System was established in the 1990s for the purposes of calculating the amount of water available for allocation. The underlying hydrologic data is from a 30-year period, 1958 through 1987. Science agencies, including the National Weather Service and Natural Resources Conservation Service update their base period every ten years and are now working from a base from 1980 to 2010. The Water Resources Department proposes to update its system to match those same base years.

## Encourage Inter-Agency Work

The state could do better when it comes to integrating agency functions related to water. In 2015, the state "mapped" Oregon's Major Water-Related Institutions,[7] creating a document showing their involvement in water resources management at the local, state, federal, and tribal levels. This mapping document describes each entity's area of responsibility, relevant programs, and available data. The document was developed to strengthen the public's understanding of inter-agency linkages. It may also help identify areas where agencies can improve coordination in data collection, field work, and decision-making. Such a tool is difficult to keep up-to-date and should be revised regularly.

**Figure 1-12: Lidar Coverage in Oregon**




One example where agencies have recently collaborated is in the review of water right permit applications. The Departments of Fish and Wildlife, Environmental Quality, and Water Resources have revisited their forms, process flow, and online collaborative workspace in order to process applications more efficiently and consistently.

Another example of collaboration is the state's Lidar Program (Airborne Light Detection and Ranging). This is a remote sensing tool that provides three-dimensional surface terrain data for the state.

In 2007, the Oregon Legislature designated the Department of Geology and Mineral Industries (DOGAMI) as the lead agency for lidar acquisition in Oregon. DOGAMI established the Oregon Lidar Consortium (OLC) in order to build funding for the acquisition of large swaths of lidar across the state. These data help create geologic maps, flood hazard maps, evaluate tidal channel topography, locate infrastructure, model water quality, delineate wetlands, evaluate habitat restoration, assess hazards, and inventory forests.

To date, the Oregon Lidar Consortium has completed 66 large lidar collections totaling nearly 49,000 square miles. Excluding serial lidar data sets, the Consortium has collected lidar for 45 percent of the state, covering 94 percent of the populated areas. The lidar coverage includes all of the Willamette Valley, the entire coast of Oregon, the western portions of the I-84 corridor, as well as recent completions of the Rogue and Deschutes Basins. Refer to Figure 1-12.

Over the past few years, the Oregon Lidar Consortium has been working with various state and federal partners to enhance lidar coverage in Eastern Oregon. As of 2014, the OLC had acquired ten lidar collections covering over 3,500 square miles. An additional three OLC projects are currently being collected in portions of Baker, Grant, Harney, and Wheeler Counties.

Improving data collection and coordination should extend beyond state agencies. It should include a variety of partners—public and private—that share similar data needs related to water.

### A Strategic Enterprise Approach to Monitoring

Oregon's Stream Team was created in June 2013 and is made up of many of the state's natural resources agencies, all of which monitor Oregon's waters for various public purposes. State agencies that make up this team include:

- Department of Agriculture
- Department of Environmental Quality
- Department of Fish and Wildlife
- Department of Forestry
- Department of State Lands
- Oregon Health Authority
- Oregon State's Institute of Natural Resources
- Water Resources Department
- Watershed Enhancement Board

The Stream Team facilitates collaborative decision-making to support a healthy environment through coordinated planning, monitoring, and communication of water-related data and information. The work of the Stream Team directly supports the intent of the Integrated Water Resources Strategy, improving water resources data collection and monitoring by coordinating inter-agency efforts.

Thus far, the Stream Team has developed a collaborative workspace for agency partners and a monitoring calendar and associated map that are updated annually. Members meet regularly, where agencies provide input on statewide water-related monitoring issues, such as new stream gages, harmful algae bloom coordination, environmental data management strategies, and more.

The Stream Team is currently drafting an inter-agency statewide monitoring strategy and planning a "water monitoring summit" event for the North Coast basin in 2018. Various state and local entities will be invited to share recent monitoring-related work or priorities around water quality and quantity, surface water and groundwater, and fish and wildlife.

The North Coast Monitoring Summit was inspired by a similar gathering in 2013, organized by the Oregon Department of Environmental Quality and held in Northeast Oregon. More than 30 state and federal agencies, tribes, environmental organizations, businesses, and watershed councils participated, with several overlapping themes emerging from the summit.[8] Oregon DEQ and other entities can use events such as these to inform updates to monitoring priorities.

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

Examples of how to implement this action:

- Improve coordination of data sets
- Improve data availability using on-line platforms and emerging technologies, mobile apps, and open standards
- Develop or update modeling and other decision-support tools
- Encourage inter-agency work among a variety of partners

### Observations

Scientific information is a critical input into water-related decisions in both the public and private sectors. This chapter and the remaining chapters provide examples where this information is and should continue to be put to use.

## Recommended Actions at a Glance

| Critical Issue | Recommended Action |
|---|---|
| **Limited Water Supplies and Systems; Water Management Institutions; and, Water Quality & Quantity Information.** | **1.A Conduct Additional Groundwater Investigations**<br>**1.B Improve Water Resources Data Collection and Monitoring**<br>**1.C Coordinate Inter-Agency Data Collection, Processing, and Use in Decision-Making** |

# References

[1] U.S. Geological Survey. 1987. Average Annual Runoff in the United States, 1951-80. https://pubs.er.usgs.gov/publication/ha710

[2] U.S. Geological Survey. 2001. Groundwater Hydrology of the Upper Deschutes Basin, Oregon. Water-Resources Investigations Report 00-4162. https://pubs.usgs.gov/wri/wri004162/pdf/WRIR004162.pdf

[3] Oregon Water Resources Department. 2016. Water Resources Monitoring Strategy. Salem, Oregon. http://www.oregon.gov/owrd/LAW/docs/IWRS/MonitoringStrategy.pdf

[4] Oregon Water Resources Department, 2016. Water Rights in Oregon: An Introduction to Oregon's Water Laws. Salem, Oregon. http://www.oregon.gov/owrd/PUBS/docs/aquabook.pdf

[5] U.S. Environmental Protection Agency. 2016. Emergency Administrative Order, Safe Drinking Water Act, in the matter of the City of Flint Michigan. https://www.epa.gov/sites/production/files/2016-01/documents/1_21_sdwa_1431_emergency_admin_order_012116.pdf

[6] Oregon Department of Education. 2016. Healthy and Safety Schools Plan. Oregon Administrative Rules (OAR) 581-022-2223 http://www.ode.state.or.us/superintendent/priorities/1.-attachment-1---healthy-and-safe-schools-plan-oar-58-022-2223-8-15-16-final.pdf

[7] Oregon Water Resources Department. 2015. Mapping Oregon's Water-Related Institutions. Salem, Oregon. http://www.oregon.gov/owrd/LAW/docs/IWRS/Program_Mapping_January_2015.docx

[8] Borisenko, Aaron; Oregon Department of Environmental Quality. 2012. Oregon DEQ's 2012 Monitoring Summit: Why did we do it and what did we learn? Presentation to the National Water Quality Monitoring Council. https://acwi.gov/monitoring/webinars/webinar_OR-DEQ_Monitoring_Summits_11142012.pdf

# CHAPTER 2

## Understand Instream and Out-of-Stream Needs

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, recreation, and essential habitat for fish and wildlife.

A clean and reliable source of water is critical 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 environment 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.

Oregon continues to seek better information about 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.

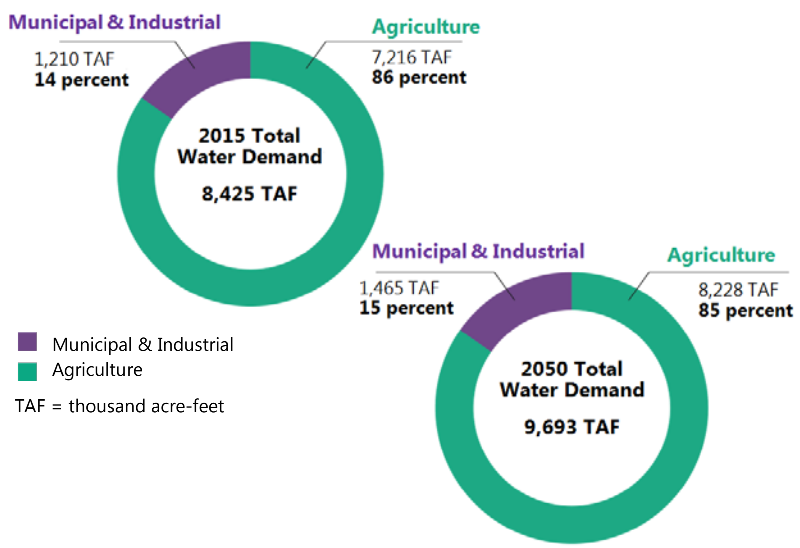
**Quick Links to Main Sections:**

# Critical Issue – Further Define Out-of-Stream Needs / Demands

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 agriculture, municipal, industrial, and domestic purposes.

Uses that divert water are often considered a "consumptive" use. Today, water users in Oregon divert about 8.4 million acre-feet of water each year for out-of-stream uses, mostly during the spring and summer months when demand is at its highest. This annual volume of water demand represents approximately eight percent of the more than 100 million acre-feet of water that fills Oregon lakes, streams, and aquifers.[1]

**Figure 2-1: Forecasted Change in Consumptive Water Demand by 2050**




Oregon's 2015 Long-Term Water Demand Forecast[2] describes potential long-term consumptive use demands in an Oregon that may not be able to rely on historic patterns to predict future rainfall and snowpack.

Some counties and basins may face important changes by 2050 because of growth in water demand. The total change in demand rests on numerous assumptions about the future, assumptions that communities, governments and private partners can address together.

The 2015 scenarios and assumptions include a projected increase in both population and a longer, warmer growing season, leading to more demand by agricultural, commercial, residential and industrial water uses in 2050. If future climate conditions are both hotter and drier, Oregon could be faced with a need for an additional 1.3 million acre-feet of water annually.

### Water Use in Agriculture

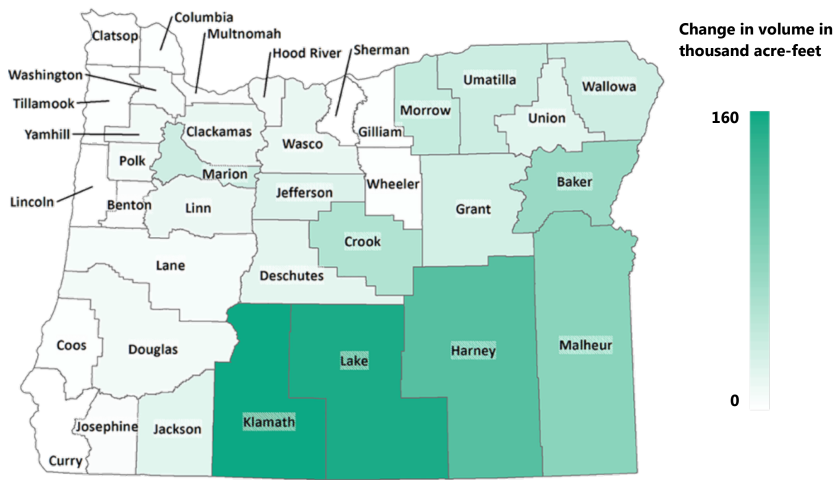
The majority of water used to grow crops comes from irrigation. The state's 2015 demand forecast indicated that irrigated agriculture uses an estimated 86 percent of the water that is diverted from surface water or pumped from groundwater sources.

Increases in agricultural water demand are expected from a range of possible changes in the climate resulting in prolonged agricultural growing seasons, increased day-to-day crop water consumption, and a larger annual water demand for sustaining Oregon's current agricultural lands.

Counties with the most irrigated acreage may experience the largest volumetric increase in agricultural water demand by 2050. The five counties with the highest projected volume increase in agricultural demand account for 45 percent of the irrigated acreage in Oregon today, and are: (1) Klamath, (2) Lake, (3) Harney, (4) Malheur, and (5) Baker. Refer to Figure 2-2.

Because of higher demands for water, some areas of the state may also have to adjust how they meet those demands. Oregon's northwest counties have traditionally relied more heavily on precipitation than irrigation. Although total annual precipitation is likely to stay the same, it may be less available in the summertime to water crops. Irrigation may play a more important role in the future.

**Figure 2-2: Forecasted Change in Agricultural Water Demand by 2050**




**Contributions of Irrigated Agriculture**
Oregon agriculture provides a bounty of food and fiber products that are sold and consumed in Oregon and around the world. Yields of crops, including grains, can increase up to 500 percent, if irrigated. The Oregon Board of Agriculture 2017 industry report notes that 40 percent of Oregon's farms rely on some level of irrigation. The Board further notes that without safe, adequate supplies of water, Oregon's agricultural sector would look very different than it does today, both in terms of what can be produced in the state and as an economic contributor[3]

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 supports one of Oregon's highest ranking commodities – cattle and calves – valued at $914 million in 2015. Without water, none of this is possible.

Irrigated agriculture contributes significantly to the economy, food supply, and to local communities. The Department of Agriculture reports that Oregon's almost 35,000 farms produced more than 220 different products in 2015.[4] Oregon State University Extension calculated the state's 2015 agricultural production at $5.7 billion, making it a top economic driver in Oregon.[5] 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. In Oregon, irrigation with its related water rights more than doubles the value of crop land, from $1,950 per acre to $4,360 per acre, according to Oregon Agripedia.[6] Oregon State University Extension attributes 14 percent of Oregon jobs to agriculture, as well as $23 billion—or 11 percent—of the state's economy.[7]

The contribution of agriculture to Oregon's environmental health is also significant. Many agricultural fields serve as viewsheds 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.

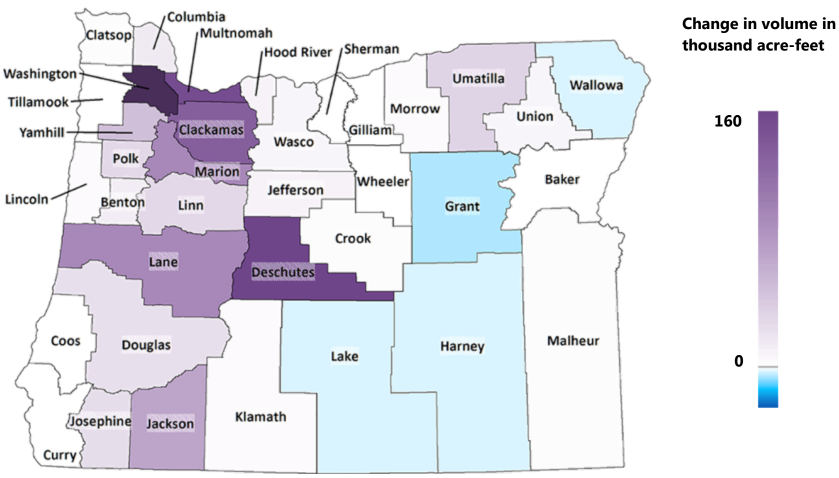
**Food Processing —** Oregon hosts hundreds of food manufacturing companies that play an essential part in food production by cooking, freezing, and packaging products for consumers. The food processing industry handles crops from cherries to onions and includes bakery and dairy products, fruits and 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.

## Municipal and Industrial Water Use

Municipal and industrial (M&I) demands, which collectively includes municipal service use, industrial use, water use in unincorporated areas, and self-supplied industrial use, accounts for approximately 14 percent of out-of-stream demands today.

Municipal service use, on its own, accounts for slightly less than 6 percent, or 490,000 acre-feet, of consumptive water demands today. 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.

**Figure 2-3: Forecasted Change in Municipal and Industrial Water Demand bv 2050**




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 residences, schools, parks, hospitals, industries, businesses, and other public and private facilities. In the past decade, manufacturing has largely been located in urbanized areas where access to a public water system has played an important role. The ability of municipal water systems to deliver reliable, high quality water supplies is one factor that has attracted industry to Oregon.

In the 2015 *Long-Term Water Demand Forecast*, M&I demands are anticipated to increase by 20 percent by 2050, resulting primarily from a projected 40 percent increase in population, or another 1.5 million residents.[8] Ongoing and planned conservation measures are expected to help temper water demand for many communities. However, the weighted average per capita M&I water demand for Oregon is projected to remain about the same as current conditions, increasing approximately 0.7 percent. Industrial and commercial demands served by municipal water systems are included in the projection of per capita demand. Most population growth is forecasted to occur in Oregon's large urban areas, with central Oregon projecting the highest percentage growth through 2050. Conversely, rural and unincorporated areas are expected either to remain stable in population or to experience some decline.

The counties with the highest projected volumetric increase in M&I water demand by 2050 are: (1) Washington, (2) Deschutes, (3) Multnomah, (4) Clackamas, and (5) Lane. Refer to Figure 2-3. The M&I demands for some counties are forecasted to increase more than the statewide average of 20 percent.

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

Today, municipalities forecast water and wastewater demands and provide services to all who locate within their service territory. They often estimate the growth that might occur five, ten, even 50 years into the future and must be ready to serve that need.

**Water Demands for Self-Supplied Industries –** Today, self-supplied industrial water use represents just above six percent of the water diverted in Oregon, or 534,000 acre-feet. These self-supplied industrial and commercial facilities 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.

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 or delivery of goods, services, or commodities, along with the use of water to construct, operate, or maintain a facility.

For self-supplied industrial demand, Multnomah, Lane, Columbia, Clatsop, Clackamas, Marion, and Linn counties lead this category. Others with relatively large self-supplied industrial demands include Coos, Umatilla, Deschutes, and Douglas counties.

Self-supplied industrial demands served from separate and individual water rights are not projected to increase.

**Water Demands for Rural or Unincorporated Areas –** Municipal service or well water use outside of urban growth boundaries accounts for about two percent, or 187,000 acre-feet, of consumptive water demands in Oregon. This demand includes individual domestic well use. Although this amount of water is small in comparison to other out-of-stream demands, it represents an estimated 230,000 wells. The largest demands are in Washington, Clackamas, Deschutes, Jackson, and Josephine counties. These counties comprise more than 60 percent of water demands for unincorporated areas.

## Update the State's Long-Term Water Demand Forecast

The state should regularly update its fifty-year forecast of water needs across all sectors. Such a forecast includes identifying trends in water use, economic development, urban-rural population growth/shift, per capita demands, and changing crop water requirements due to a changing climate.

Additional forecasting is also necessary to determine instream flow needs. See Recommended Action 3.A for more details. Long-term water demand forecasting should be incorporated into place-based, integrated water resources planning efforts. For further discussion of place-based efforts, refer to Chapter 4.

As previously discussed, productivity of land and crop production can increase several-fold with the application of water. This expands the options of crops that can be grown, lowers the risk of impacts from harsh weather and disease, and generates additional revenues in the broader economy. Although the 2015 demand forecast held the mix of crops and the footprint of irrigated lands constant, in reality, planting and irrigation decisions will continue to change across the landscape, along with the climate.

As one example, wine grapes are a sensitive crop that may be affected by climate change. The regional climatic conditions that produce an optimum quality are considered to be narrow and differ for each varietal, ultimately putting wine grapes at a heightened risk to climatic variations and change. Research has shown that some of the gradual, historical shifts in the climate (1948 through 2002) have been beneficial to some wine grapes currently grown in Oregon.[9] However, the projected changes over the coming century may not continue to benefit wine grapes and could result in the migration of optimal conditions to more northerly regions that have traditionally been too cold for cultivation.[10] While these anticipated changes may occur over a period as long as 50 years, Oregon's wine grape growers have begun considering adjustments to watering practices, varietal choices, and locations of vineyards. These decision points will continue to be made across the agricultural sector in the coming years.

Quantifying and modeling the economic value of water (both instream and out-of-stream) will add to the value of such forecasts. For instance, the productivity of land increases 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.

### Expand the Use of Satellite Data

The use of evapotranspiration data developed from satellite imagery is an emerging measurement tool that helps us determine the location, timing, and quantity of agricultural water use.

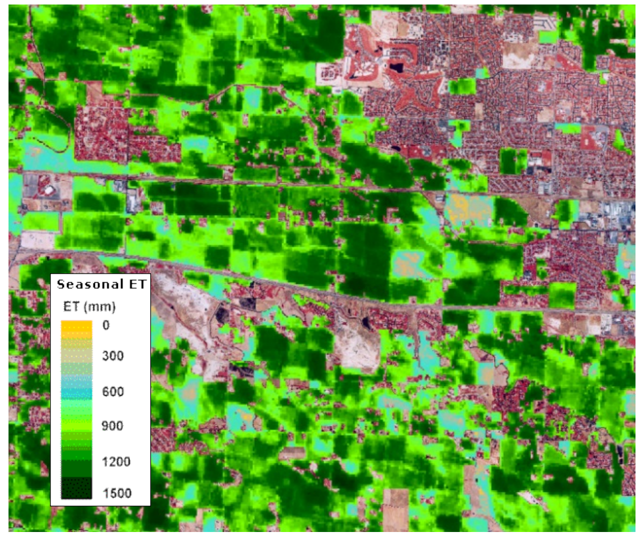
Evapotranspiration (ET) is water that transpires from the leaves of plants and evaporates from soil. Calculating ET data can show the amount of water consumed by irrigated agriculture and by other lands. Figure 2-4 shows a sample satellite view at the field scale, although images can also be scaled to the county, basin, or state-level. Darker green areas connote higher ET; brown areas are not irrigated or non-crop areas.

Remote sensing approaches transform thermal and reflected spectral imagery from Landsat satellite images into evapotranspiration images. The specific techniques used are referred to as METRIC (Mapping EvapoTranspiration at high Resolution using Internalized Calibration). METRIC is an energy balance model that computes and maps ET using Landsat images.

The METRIC approach provides 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.

Other states began using METRIC more than a decade ago. Idaho was a key partner in its development and has been using it ever since. The Desert Research Institute out of Nevada is in the process of modernizing methods of calculating ET from thermal and spectral imaging.

**Figure 2-4: Sample Satellite View**




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

Examples of how to implement this action:

- Periodically update demand projections with new population, per capita water demand, industrial demand, crop water use, and climate projections
- Develop models/studies to quantify the economic, social, and cultural value of consumptive uses of water
- Employ remote sensing to improve crop water use estimates

Along with four other western states, Oregon is currently a co-investigator in a project sponsored by the National Aeronautics and Space Administration. Focusing first in the Greater Harney Valley, this project utilizes the METRIC approach with the added benefit of enabling end-users to readily access ET information for the region.

## Improve Water-Use Measurement and Reporting

Objective water management decisions are made possible when they are based on reliable information about water use. Availability of water use data is fundamental 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 models. Although the state has the authority to require users to measure water use, it does not have broad authority to compel reporting of the resulting data.

Water users who do keep track of their use are better able to demonstrate the validity of their water rights, to develop water management and conservation plans, and to determine the design and funding needs of their future water systems.

### Water-Use Measurement and Reporting Program

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. Approximately 17 percent of Oregon's water rights are required to report their water use to the state; this represents approximately 30 percent of the water that is authorized to be diverted. In 2013, the Oregon Legislature reinstated the position overseeing the state's Water-Use Reporting Program, as percent reporting to about 70 percent consistently today. In order to ensure continued effectiveness, funding for this program should be sustained.

In 2016, the U.S. Geological Survey awarded the state a grant to develop a workplan that identifies potential improvements to the Water-Use Reporting Program. The workplan sets forth a number of goals in the areas of data quality (improving the quantity, availability, reliability, and integrity of the water-use data) and accessibility for on-line users. Program staff are using the workplan to guide needed adjustments and make improvements over time. Exploring the use of emerging measurement tools could also help improve the accuracy of water use information.

### 2000 Strategic Measurement Plan

In 2000, the Water Resources Commission developed a strategic measurement plan focused on diversions of surface water with the greatest impact on streamflows in areas with the greatest needs for fish. A statewide inventory was conducted, helping to identify approximately 2,300 "significant diversions" within nearly 300 high priority watersheds across the state. The Commission updated the plan in 2007.

The Department's field personnel work with landowners to implement the Commission's *Strategic Measurement Plan*,[11] installing measurement devices (e.g., weirs, flumes, and meters) at these significant diversions. By the end of 2015, nearly 1,000 measurement devices had been installed. However, many of the inventoried diversions are no longer in use, and many of the diversions have no requirement to report on water use. The plan's focus on surface water left out an important measurement need: groundwater. Given that the program is 17 years old, the inventory and approach underpinning this program needs to be assessed and updated.

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

Examples of how to implement this action:

- Continue to improve the software and tools used for water-use measurement and reporting
- Improve the state's authority to require reporting of water use
- Update and implement the Water Resources Commission's Strategic Measurement Plan, measuring significant diversions
- Coordinate the Water-Use Reporting Program and Commission's Strategic Measurement Plan

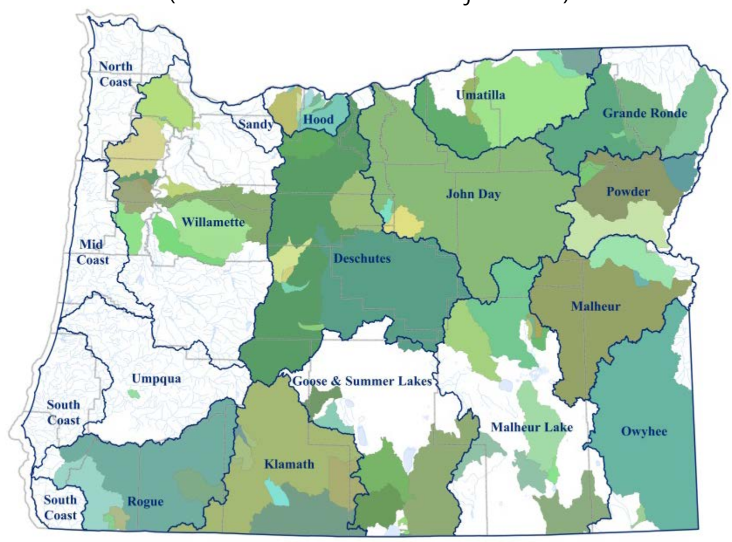
Cost-share dollars for measurement devices are critical to the program's success. The 2013 Oregon Legislature placed funding for this cost-share program into the Water Resources Department's base budget so that it could partner with water users in these efforts. The 2017 Oregon Legislature expanded the cost-share program to include groundwater withdrawals.

## Determine Unadjudicated Water Right Claims

In many parts of Oregon, landowners began using water long before the Oregon Water Code was enacted. Passage of the Water Code by the Legislature in 1909 established, for the first time in Oregon, a centralized administrative system for acquiring rights to the use of surface water. These water rights are managed within a prior appropriation system of water allocation.

Claims to the use of surface water that predate the Oregon Water Code are required to go through a formal administrative judicial process known as an adjudication, to have their water right claims quantified, documented, and eventually incorporated into the prior appropriation system. Although not discussed in detail here, there are similar procedures for conducting adjudications for groundwater uses that pre-date the Department's authority to issue groundwater rights.

**Figure 2-5: Status of Surface Water Adjudications**
(colored areas have been adjudicated)




The ability to manage water resources has been greatly facilitated in those areas of the state where adjudications have been concluded. Adjudicating water right claims creates an enforceable system that is protective of senior users in times of shortage. Without the adjudication process, these claims cannot make calls for their water or take advantage of water management tools, such as transfers or leases.

The state's most recent adjudication proceeding started back in 1975 in the Klamath River Basin. In 2013, the state completed the administrative phase of the Klamath Basin Adjudication. The Klamath County Circuit Court is now assessing the Amended and Corrected Findings of Fact and Order of Determination (ACFFOD). Adjudication claimants or contestants who dispute the Department's determinations had an opportunity to file exceptions with the Klamath County Circuit Court. After review, the Court will issue a water rights decree, either affirming or modifying the ACFFOD. The Water Resources Department can then issue water right certificates in accordance with the decree.

The remaining unadjudicated areas for surface water, shown in white in Figure 2-5, consist primarily of river basins located west of the Cascades. In some instances, federal reserved rights, including tribal claims, still have not been determined in basins that have been adjudicated. Tribes play an important role in the resolution of water rights claims in basins throughout the West. The need to resolve tribal and federal rights in Oregon is real and significant.

**Recommended Action 2.C**
**Determine Unadjudicated Water Right Claims**

Examples of how to implement this action:

- Conduct surface water and groundwater adjudications
- Settle federal reserved claims, including tribal claims

Future tasks include conducting adjudications where needed to resolve surface water and groundwater claims. Additionally, there is a need to determine federal reserved rights, including tribal rights, which may be resolved as part of an adjudication or through a settlement.

## Update Water Right Records

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 land with its appurtenant water rights. More than 74,000 certificates are held by water users. The state needs the ability to respond to holders of water rights who are asking to modify the names on these certificates. Having this authority will enable the state to update ownership information in its records.

This authority will also help facilitate Water Resources Department processes, such as communicating with water right holders, researching water rights, mapping water rights with geographic information systems (GIS), updating the water rights database, and improving compliance with measurement and reporting conditions.

A legislative concept was introduced during the 2013 Legislative Session to authorize such updates. The bill did not move out of committee.

**Recommended Action 2.D**
**Authorize the Update of Water Right Records with Contact Information**

Examples of how to implement this action:

- Authorize the Water Resources Department to update names on water right certificates
- Update related water right records, including databases and geographic information system (GIS) layers

## Oregon's Water-Related Permitting Guide

In Oregon, protecting our natural and cultural resources and the benefits they provide 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 natural resources agencies to ensure that water quality, ecological needs, and land use goals and requirements are integrated into the decision-making process. The Water Resources Department acts as the lead in this process, soliciting comments from other agencies and the public, and placing conditions on 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. Some new groundwater uses require mitigation.

In 2013, the Oregon Department of State Lands revised its Water-Related Permitting Guide[12] for the regulatory and nonregulatory programs that influence the permitting of projects in wetlands and waterways. Updating the permitting guide has been done with existing resources, as time allows. Oregon's permitting guide contains contact information, web links to application forms, review standards, and references to applicable rules. This information changes and should be updated on a regular basis.

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

Examples of how to implement this action:

- Provide updated agency contacts, policies, and links
- Provide industry-specific information, where possible

The next edition of the permitting guide could be updated to reflect new or emerging industries. The revised guide could also take the form of a one-stop shop document, and include any administrative instructions to guide application reviewers, sister agencies, and the public. An accompanying online application portal that could accept all water-related permits more efficiently is a request that agencies often hear.

# Critical Issue – Further Define Instream Needs / Demands

The water that is not diverted during the course of the year supports a variety of instream needs. A portion of this water, approximately 19 million acre-feet, is protected by more than 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 transportation, recreation, tourism, and fishing.

Oregon's water resources serve as scenic attractions and directly support the habitat needed for species to live and thrive. Our rivers and streams, lakes, reservoirs, aquifers, wetlands and estuaries all contribute greatly to our economy and health. Without adequate water within the system, instream uses and their associated economic and ecological benefits are threatened and may be degraded.

## Water Instream Supports Economic Health

Instream flows have helped with society's economic development needs, from navigation and transportation of goods, to recreation and fishing—both for sport and for commercial purposes. A number of recent reports and studies are able to help quantify these benefits.

### Navigation

The state's waterways have long served as important routes for travel and trade. According to the American Society of Civil Engineers (ASCE),[13] Oregon boasts 680 miles of inland waterways, ranking 15th nationally. ASCE further calculates that 32.1 million short tons of cargo moved through Oregon in 2014, ranking Oregon 25th in the nation. Many of the agricultural products grown in Oregon and elsewhere in the United States move down the Columbia River by barge. Instream flows facilitate ocean-going and river-going commerce, and promote economic activity at ports and cities throughout Oregon. During 2015, the Port of Portland[14] was home to 400 companies. The Port provided 700 marine-related jobs and brought $629 million to the region through its marine-related activities.

### Water-Related Recreation and Tourism

The focal point of many recreational activities in Oregon is often a river, waterfall, lake, wetland, or 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. In a 2011-12 survey, the Outdoor Industry Association[15] estimated that all outdoor recreation in Oregon generates $12.8 billion annually in consumer spending, and supports 141,000 direct jobs—$4 billion in wages and salaries. These numbers are roughly similar to statistics in Nevada, Utah, Colorado, and Arizona, but far below those in Washington and California.

According to the most recent national survey by the U.S. Fish and Wildlife Service,[16] 1.8 million Oregonians and nonresidents (16 years old and older) fished, hunted, or watched wildlife in Oregon in 2011. This group spent $2.7 billion on hunting, fishing, and wildlife-related recreation in the state over the same time period. Many of Oregon's counties, such as Harney, Lake, Morrow, and Wheeler, 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 water instream for the benefit of future generations.

Many of the state's day-use parks and overnight camping facilities reside along 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. Each year, these facilities[17] host an estimated 46 million daytime visitors (4th in the nation), and 2.5 million campers (8th in the nation).

Boating and kayaking are popular recreational activities as well, with more than 168,000 recreational boats in the state.[18] There were nearly 2.2 million boat-use days in Oregon during the 2013 boating season, according to the Oregon State Marine Board's triennial survey[19]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 were the most popular rivers, and Lake Billy Chinook, Brownlee Reservoir, Detroit Lake, Wallowa Lake, Prineville Reservoir, and Diamond Lake were the most visited lakes and reservoirs.

### 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,[20] in 2011, there were about 5.2 million fishing days spent by Oregon residents and non-resident freshwater anglers and more than 600,000 fishing days spent by resident and non-resident saltwater anglers. In 2011, the economic impact of sport fishing in Oregon, in both freshwater and saltwater environments, totaled more than $680 million in retail sales, supporting more than 11,000 related jobs in Oregon, and generating an economic output nearly 1.2 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 the commercial fishing industry,[21] more than 210 million pounds of fish were delivered to Oregon ports in 2015. The harvest value of onshore landings was $136.2 million. The estimated total personal income generated by Oregon's commercial fishing industry (onshore and distant water fisheries) in 2015 was $489 million. The Dungeness crab fishery typically dominates the commercial fishing industry, accounting for about one-third of the state's onshore landing harvest value for the 2010-14 period. Commercial fisheries support thousands of jobs and a number of communities along the Oregon Coast, providing up to a third of the annual earned income in some towns. A healthy fishery can support a cluster of fish processing plants, mechanics, machine shops and welders, refrigeration specialists, marine electronics sales and service firms, boat yards, 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.

### Hatcheries

The Oregon Department of Fish and Wildlife operates more than 30 hatcheries and several rearing ponds statewide. These facilities raise salmon, steelhead, and several species of trout. Hatcheries play a vital role in the state's overall efforts to maintain healthy fish populations and supplement recreational and commercial harvests. Each year, the state raises and releases more than 50 million fish from hatcheries. Clean, cold water is critical for the proper functioning of these facilities.

## Water Instream Supports Ecosystem Health

Along with supporting the economy, water is needed within the environment to ensure overall ecosystem health. Streamflow from rainfall and snowmelt sustains aquatic and terrestrial life. Springs, rivers, lakes, and wetlands are also dependent on the discharge of groundwater to the surface. Other ecosystems such as riparian areas, some forests, 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 when the current is swift. The complexity of the habitat directly contributes to the health and function of fish-bearing streams.

In 2015, the Oregon Department of Environmental Quality, U.S. Environmental Protection Agency, and the National Oceanic and Atmospheric Administration announced a partnership under the Clean Water Act to locate, protect and restore zones of cold water habitat for fish in the Columbia and lower Willamette Rivers.[22] Salmon and steelhead need "cold water refugia" during their migrations upstream on the way to spawn. Such safe havens play an important role in the survival and migration of adult salmon and steelhead as rivers warm during the summer.

## Determine the Flows Needed to Support Instream Needs

A healthy stream experiences base flows as well as a variety of elevated flows that provide habitat maintenance and other ecosystem functions. This section looks at next steps for understanding base and elevated streamflows and for assessing groundwater-dependent ecosystems.

### Instream Needs

Instream flow provides habitat for native fish, which have a high economic and social value in Oregon.
The ability to meet instream needs is limited by our understanding of instream flows.

While scientists know that a wide variety of ecosystems and species depend upon a spectrum of flows (frequency, magnitude, and timing), it is difficult to quantify those needs precisely. It is also difficult to predict the degree of ecological degradation that occurs with differing qualities and quantities of water.

The Oregon Department of Fish and Wildlife, Department of Environmental Quality, and Parks and Recreation Department are authorized to apply for instream water rights for specific purposes, such as the protection of fish habitat, water quality, and scenic values. Such applications require scientific analysis and modeling to determine the base flows needed to meet the physical habitat requirements of target species and life stages. Certificated instream water rights come with legal status and protections under the prior appropriation system.

In general, the state has very little capacity to monitor whether all instream water rights are being met. There are more than 1,400 instream water rights in place, whereas, the state only has stream gages in place to monitor 205 of them. To fill this gap, the Water Resources Department's field personnel often take additional streamflow measurements in locations that are not monitored with permanent equipment.

The Department of Fish and Wildlife's flow recommendations reflect the best available information on the biological requirements of fish present. As such, instream water rights can be used to set goals for flow restoration for fish, wildlife, and their habitats. To date, agencies have established instream water rights to protect minimum flows and they focus almost exclusively on depth, velocity, and substrate criteria.

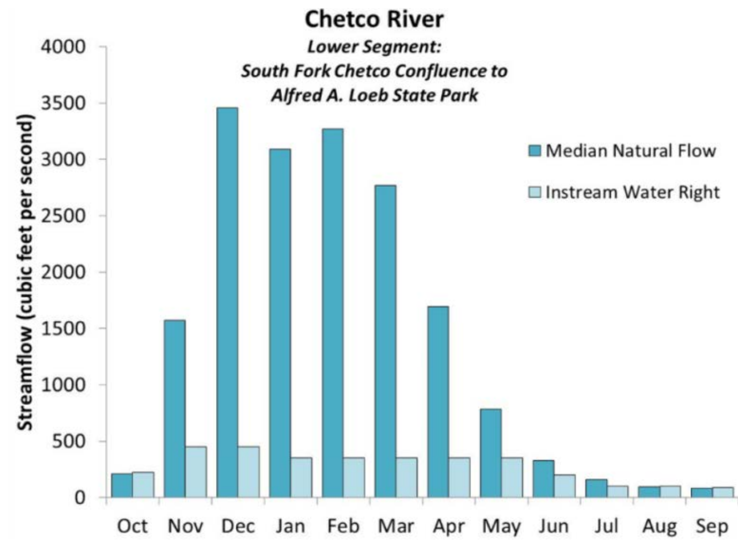
As demonstrated in the sample bar graph, instream water rights held by agencies are relatively consistent throughout the year, as they have been designed to protect the physical habitat requirements for rearing, spawning, and other life stages.

Today's instream water rights typically do not follow the shape of the hydrograph during the course of the year and are not protective of the elevated flows that provide benefit to the overall ecosystem.

Some protections do extend to ecological-elevated flows, such as the determined claims held by The Klamath Tribes. Holding the most senior priority dates in the Klamath Basin, the Klamath Tribes have the ability to support riparian and geomorphic functions during periods of high flow.

There are other mechanisms that can be used to protect water instream, such as water leases and transfers. Additional discussion about these tools can be found in Chapter 4.

**Figure 2-6: Comparison of Streamflow to an Instream Water Right**




## Understand Ecological Base Flows and Ecological-Elevated Flows

Flow functions are often grouped into the following categories:

**Ecological Base Flows –** Ecological base flows discussed here are different from the hydrologic use of the term base flow—which describes the contribution of groundwater to streams, a primary source of water during dry summers. Ecological base flows are established as a lower protective threshold to provide physical habitat space for fish and other aquatic organisms. Ecological base flows are defined in order to be sufficient in flow for incubation, rearing, and spawning for key species over long periods of time. While there is information about base flow needs for the high-profile salmonid species, there is less information about base flow needs for other species including lamprey, chub, white fish, other native fish species, amphibians, or macroinvertebrates.

The Department of Fish and Wildlife conducted base flow studies even prior to adoption of the 2012 Strategy, as time and resources allowed. In preparing new instream water rights, the state identified streams with completed studies, and will prioritize and complete new studies and those that require updates. The 2015 Legislature authorized and funded limited duration biologists to conduct studies, which are currently underway based on a prioritized selection of areas and/or stream reaches. The Department of Fish and Wildlife will need consistent resources to pursue its instream work objectives.

**Ecological-Elevated Flows –** These flows are a subset of instream flows that are directly related to the ecology of the stream system. They include biological triggering flows that may elicit 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 that rework the channel or streambed, rejuvenating or cleaning gravel, flushing sediment, reforming habitat features, replenishing or rejuvenating riparian vegetation, and/or re-establishing connectivity with off-channel habitats.

More information is needed with regard to ecological-elevated streamflows. The state can begin by developing criteria to determine the elevated flow needs in each water basin/watershed.

Some water projects using implementation funds from the state under Senate Bill 839 (2013)[23] will need flow prescriptions that describe the duration, timing, frequency, and volume of flows required to maintain the biological, ecological, and physical functions of the watershed. The first of those efforts began in 2017.

**Long-Term Instream Demand Forecast –** As discussed earlier, the state has completed two long-term demand studies that focused on forecasting consumptive demands for agricultural, municipal, domestic, and industrial uses. A parallel analysis for instream needs has not been completed. The state should conduct a long-term instream demand forecast study, characterizing the species, water quality, and water quantity needs by location.

The state is developing a study approach that considers watershed characteristics like temperature, discharge, land cover, precipitation, slope, and elevation. Climate projections will also be important to better understand how water quality and quantity could change in the future.

Combining this information with species distribution would allow comparison of current and potential streamflow (i.e., volume and timing) relative to the needs of fish species throughout their lifecycle. A study like this could examine locations where the volume of water rights outstrips streamflow during the summer months, signaling stream reaches that are potentially vulnerable during periods of drought.

Understanding when and where species may be vulnerable can inform streamflow and habitat restoration efforts and areas in need of additional study. The study could also identify where to establish future measurement sites or additional instream water rights. Lastly, such a study could help pinpoint where mitigation (actual water) is needed. Increasingly, entities applying for water rights are required to develop mitigate measures to minimize the effects of the proposed use on fish species.

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

Examples of how to implement this action:

- Prioritize and install gages in additional locations to monitor the status of instream flows and water rights
- Identify basins with listed species and install monitoring equipment to help characterize the suite of flows through these basins
- Conduct instream needs studies, such as base flow studies and elevated flow requirements or prescriptions
- Pursue a consistent, model-based framework for characterizing long-term instream demand and integrate projections of future climate for planning purposes
- Develop models/studies to quantify the economic, social, and cultural value of instream uses
- Support state agency instream flow efforts and programs (e.g., ODFW, ODEQ, OPRD)

**Highlight Box**

**Connecting Consumers to Salmon-Safe Products and Places**

"For us as brewers, we've been long-time supporters of Salmon-Safe and their work with hop growers to increase environmental sustainability," said Angela Jasus, field marketing manager at Deschutes Brewery. By sourcing Salmon-Safe hops, leading regional and national craft brewers are helping to transform growing practices to protect water quality and wildlife habitat in the Willamette and Yakima valleys, two key wild salmon watersheds that are the source of 90 percent of hops in the United States.

Salmon-Safe is also partnering with Mainstem Malt to certify dryland grain growers who are restoring streamflows and building high value markets for locally grown, locally processed malt that's provided to brewers and bakers. This has led to the first fully certified Salmon-Safe beers on the market – the entire supply chain is certified safe for salmon.

Nearly two decades after first certifying farms and vineyards in the southern Willamette Valley, Salmon-Safe has transitioned more than 400 Oregon farms, including the state's leading hop growers and nearly a third of Oregon's vineyard acreage to Salmon-Safe practices that protect fish and wildlife. This "eco-label" can help consumers find products in the marketplace that benefit watersheds and salmon.

Salmon-Safe also works within the urban environment to help implement environmentally innovative site development and best management practices that benefit the watershed. The City of Portland recently became the first Salmon-Safe city after a comprehensive, three-year assessment of its planning, facilities, and operational practices at hundreds of sites across the city.

"Portland is a city of rivers, and our economic wellbeing and quality of life rise with the health of the Willamette and Columbia, our many creeks and our native endangered salmon. I am proud to leave a Salmon-Safe legacy that is now embedded in city operations."

- Charlie Hales, Mayor of Portland, October 2016

Find more information at: http://www.salmonsafe.org/.

## Assess Groundwater-Dependent Ecosystems

Groundwater is a vital source of water that sustains both ecosystems and human communities. 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 species native only to these locations. Throughout the U.S., The Nature Conservancy has found that 17 percent of species—invertebrates, vertebrates, vascular plants, and lichen—on the federal Endangered Species List are dependent on groundwater for their persistence.[24]

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.[25] Rivers such as the Williamson in the Klamath Basin or Metolius in the Deschutes have high hydrological base flow through the summer—contributed to by groundwater—and they support important populations of cold water fish species. Plants such as bladderworts and sundew, amphibians including Oregon spotted frogs and Northwest salamanders, and fish such as Bull trout all rely on a perennial source of water.

Some organizations have already taken steps toward protecting groundwater-dependent ecosystems like these. The Nature Conservancy assisted the U.S. Forest Service in developing a series of protocols for inventorying and monitoring groundwater-dependent ecosystems.[26] Using these methods, the Conservancy, in collaboration with the U.S. Geological Survey, identified 67 peat-forming groundwater-dependent wetlands known as fens in the Upper Deschutes Basin.[27] In the more arid Crooked Basin, these same researchers inventoried nearly 200 springs, which they found to be most likely connected to shallow, low discharge flow systems that are highly susceptible to climate warming.[28]

Groundwater-dependent ecosystems still need to be fully identified and characterized across the state. 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 help meet the needs of people, species, and ecosystems. For example, in the Oregon Dunes National Recreation Area, municipal wells pump water from an unconfined sand dune aquifer that also supports two sensitive species of amphibian that breed in the swale wetlands. By quantifying the groundwater needs of amphibians and wetland plants, compatible pumping levels supportive of wetland species were identified.[29]

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

Examples of how to implement this action:

- Identify and characterize groundwater-dependent ecosystems
- Quantify the water quantity and water quality needs of groundwater-dependent ecosystems

# Recommended Actions at a Glance

| Critical Issue | Recommended Action |
|---|---|
| Out-of-Stream Needs/Demands | **2.A Regularly Update Long-Term Water Demand Forecasts**<br>**2.B Improve Water-Use Measurement and Reporting**<br>**2.C Determine Unadjudicated Water Right Claims**<br>**2.D Authorize the Update of Water Right Records with Contact Information**<br>**2.E Regularly Update Oregon's Water-Related Permitting Guide** |
| Instream Needs / Demands | **3.A Determine Flows Needed (Quality and Quantity) to Support Instream Needs**<br>**3.B Determine Needs of Groundwater-Dependent Ecosystems** |

# References


[1] U.S. Geological Survey. 1987. Average Annual Runoff in the United States, 1951-80 https://pubs.er.usgs.gov/publication/ha710

[2] Oregon Water Resources Department. 2015. Statewide Long-Term Water Demand Forecast. Salem, Oregon. http://www.oregon.gov/owrd/LAW/docs/IWRS/OWRD_2015_ Statewide_LongTerm_Water_Demand_Forecast.pdf

[3] Oregon Board of Agriculture. 2017. State of Oregon Agriculture Industry Report. http://www.oregon.gov/ODA/shared/Documents/Publications/Administration/BoardReport.pdf

[4] Oregon Department of Agriculture. 2016. Oregon Agriculture Facts and Figures. http://www.oregon.gov/ODA/shared/Documents/Publications/Administration/ORAgFactsFigures.pdf

[5] Oregon State University Extension Service Rural Studies Program. 2015. Oregon Agriculture, Food and Fiber: An Economic Analysis. Salem, Oregon. http://agsci.oregonstate.edu/sites/agsci.oregonstate.edu/files/oregon_agriculture_2015.pdf

[6] Oregon Department of Agriculture. 2016. Oregon Agripedia 2015. Salem, Oregon. https://www.oregon.gov/ODA/shared/Documents/Publications/Administration/Agripedia.pdf

[7] Oregon State University Extension Service Rural Studies Program. 2015. Oregon Agriculture, Food and Fiber: An Economic Analysis. Salem, Oregon. http://agsci.oregonstate.edu/sites/agsci.oregonstate.edu/files/oregon_agriculture_2015.pdf

[8] PSU-PRC (Portland State University Population Research Center). 2015. Coordinated Population Forecasts for Region 1. Portland, Oregon. http://www.pdx.edu/prc/region-1-documents

[9] Jones, G. V. 2005. Climate Change in the Western United States Grape Growing Regions. Acta Hortaculturae. (ISHS). 680:41-60. http://www.sou.edu/assets/envirostudies/gjones_docs/GJones-ActaHorticulturae05.pdf

[10] Campbell, W.D. 2013. Spatial Analysis of Climate and Winegrape Production in Winegrape Growing Regions of Oregon. Dissertations and Theses. Paper 1442.

[11] Oregon Water Resources Department. 2007. Strategic Measurement Plan Update. Salem, Oregon. https://www.oregon.gov/owrd/docs/reports/priority_wab_report03-2007.pdf

[12] Oregon Department of State Lands. 2012. State Water-Related Permits Guide. Salem, Oregon. http://www.oregon.gov/dsl/WW/Documents/water_related_permits_user_guide_2012.pdf

[13] American Society of Civil Engineers. 2017. Infrastructure Report Card: Oregon Infrastructure Overview. http://www.infrastructurereportcard.org/state-item/oregon/

[14] Port of Portland. 2017. Fast Facts: Our Role in the Region We Serve. Portland, Oregon. http://www2.portofportland.com/Inside/FastFacts

[15] Outdoor Industry Association. 2012. Oregon Outdoor Recreation Economy Report. https://outdoorindustry.org/images/ore_reports/OR-oregon-outdoorrecreationeconomy-oia.pdf

[16] U.S. Fish and Wildlife Service. 2016. National Survey of Fishing, Hunting, and Wildlife-Associated Recreation.

[17] Oregon Parks and Recreation Department. 2017. *News Media Webpage*. Salem, Oregon. http://oregonstateparks.org/index.cfm?do=v.dsp_news

[18] National Marine Manufacturers Association. 2015. Economic Significance of Recreational Boating in Oregon. www.nmma.org

[19] Lesser, V.M., L. Newton, and A. James. 2014. Boating in Oregon: Results of the 2014 Triennial Boating Survey. Conducted for the Oregon Marine Board. Salem, Oregon.

[20] American Sportfishing Association. 2013. Sportfishing in America. http://asafishing.org/uploads/2011_ASASportfishing_in_America_Report_January_2013.pdf

[21] Oregon Department of Fish and Wildlife. 2016. Oregon Commercial Fishing Industry in 2015: Briefing Report. Salem, Oregon. http://www.dfw.state.or.us/agency/docs/OR%20Comm%20Fish%20Ec%20Impacts%20Brief%202015.pdf

[22] U.S. Environmental Protection Agency. 2015. State, Federal Agencies to Map and Protect Cold Water Refuges for Fish in Columbia and Willamette. Seattle, Washington.

[23] Oregon Legislature. 2013. Senate Bill 839. Salem, Oregon. https://olis.leg.state.or.us/liz/2013R1/Downloads/MeasureDocument/SB839

[24] Blevins, E. and A. Aldous. 2011. Biodiversity Value of Groundwater-Dependent Ecosystems. *Wetland Science and Practice.* 28:18-24. https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/oregon/freshwater/Documents/GW_Blevins%20and%20Aldous_2011_WSP.pdf

[25] Stevens, L. & V. Merestsky. 2008. Aridland Springs in North America: Ecology and Conservation. University of Arizona Press. Tucson, Arizona.

[26] U.S. Forest Service. 2012. Groundwater-Dependent Ecosystems: Levels I and II Inventory Field Guide. General Technical Report WO-86b. Washington, D.C.

[27] Aldous, A.R., M.W. Gannett, M. Keith, and J. O'Connor. 2015. Geologic and Geomorphic Controls on the Occurrence of Fens in the Oregon Cascades and Implications for Vulnerability and Conservation. Wetlands. 35(4): 757-767.

[28] Aldous, A.R., M.W. Gannett, M. Keith and J.O'Connor. The Nature Conservancy and U.S. Geological Survey, unpublished data.

[29] Aldous, A.R., R. Congdon, E. Blevins, J. Christy, Z. Freed, J. Gurrieri, L. Bach, and T. Carroll. 2017. Environmental Flows and Levels for Groundwater-Dependent Ecosystems of the Oregon Dunes National Recreation Area of the Siuslaw National Forest.

# CHAPTER 3

## Understand the Coming Pressures that Affect Our Needs and Supplies

Oregon must plan and prepare for some of the most powerful changes—such as multi-year droughts—that will continue to affect both water resources and water needs into the future. When the Integrated Water Resources Strategy was first adopted in 2012, this section on "coming pressures" felt like the topics were in the distant future. The future arrived quickly, and we find ourselves facing pressures in 2017 that are urgent and real.

Oregon Revised Statute 536.220 specifies that the Integrated Water Resources Strategy must take into account climate change, land-use change, and population growth. The Governor has also identified climate change and drought as realities for which Oregon needs to build resiliency. Preparing for extreme events, such as droughts, floods, and earthquakes are new editions to the 2017 Strategy.

This chapter addresses these issues, as well as the connection between energy and water, the intersection of water and land use, and the need to maintain, upgrade and modernize our water and wastewater infrastructure. Finally, education and outreach is another critical issue to consider as industry leaders retire and new leaders emerge. Education and outreach audiences range from school children to water professionals and the public at large.

**Quick Links to Main Sections:**

# Critical Issue – Water and Energy

The 2017 Integrated Water Resources Strategy focuses on the link between water and energy, as the two are highly interdependent. Water is used for producing electricity in Oregon. At the same time, a tremendous amount of energy is used to deliver water to where it is needed.

## Energy-Water Interdependence

Any consideration of the water-energy nexus must include an evaluation of how energy is used in water services and water is used in energy production. Although the U.S. Department of Energy released a 2014 Report examining the water-energy nexus, this topic is still largely unaddressed in water policy, studies, or planning activities in Oregon.[1] The following discussion demonstrates where more attention and analysis is needed.

### Water Needs in the Energy Industry

Water is critical for electric production. The U.S. Department of Energy estimates that nearly half of all water withdrawn in the United States is used at thermal electric power plants.

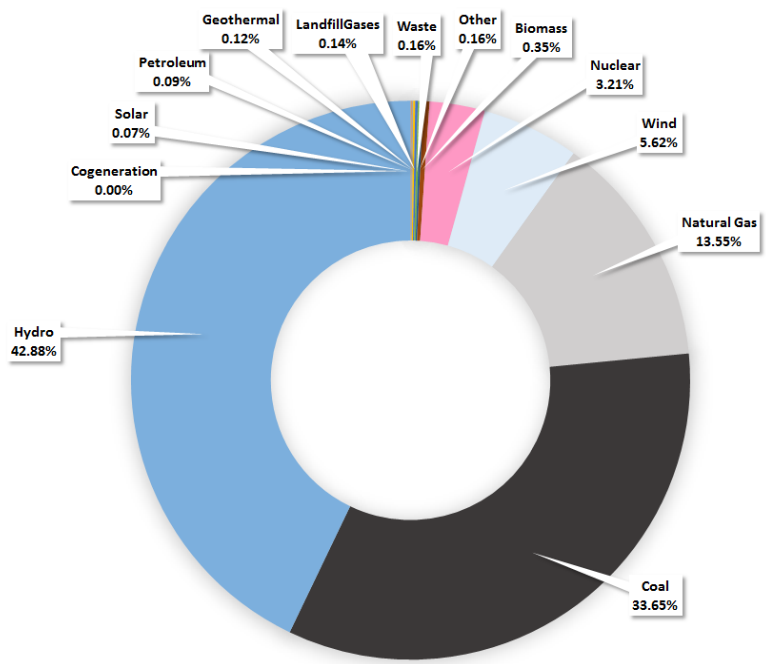
In Oregon, the electricity we use comes from energy production plants throughout the West, including hydroelectric, coal, natural gas, wind, solar, and other sources (see Figure 3-1).

About 40 percent of the electricity used in Oregon is generated by hydroelectric facilities.

The Northwest Power and Conservation Council's *Seventh Power Plan*,[2] adopted February 2016, suggests that future growth can be best served by energy conservation, followed by renewable energy.

Solar and wind facilities are the primary projects currently proposed and under construction in Oregon.[3]

**Figure 3-1: Sources of Electricity Used in Oregon**




Oregon's 2016 Renewable Portfolio Standard revision requires that 50 percent of the electricity sold by Oregon's large utilities comes from renewable resources by 2040. As the state pursues its long-term climate goals and accelerates the deployment of renewable energy resources to meet the 50 percent requirement, the state will need a better understanding of how those goals will affect water resources. Wind and solar generation facilities have minimal water needs, but new thermoelectric generation may be added to supply electricity when wind and solar are not meeting demands. Energy storage advancements could reduce the need for new thermoelectric generation.

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.

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

Examples of how to implement this action:

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

## Expand Oregon's Non-Traditional Hydroelectric Portfolio

Non-traditional hydroelectric projects will likely be part of new resources developed under the state's Renewable Portfolio Standard. According to the *Seventh Power Plan*, the most promising new generation in the hydropower sector will come from pumped storage, the addition of power facilities on existing dams, and the addition of power within existing irrigation systems. The *Plan* describes 388 megawatts (MW) of potential new capacity from efficiency upgrades at existing hydro facilities in the Pacific Northwest and up to 2,640 MW of capacity from new pumped storage facilities.

### Pumped Storage Systems

A pumped storage system consists of two reservoirs, one at a higher elevation than the other, where water moves from the upper reservoir to the lower reservoir to generate power when demand is high. Water is then pumped back up to the higher reservoir, using electricity, when electricity pricing and demand is low, usually at night. Pumped storage systems can be considered both a power management tool and an energy storage device. Currently, there are two proposals for pumped storage projects in central Oregon near Prineville and a project north of Klamath Falls. Neither proposal has been licensed or constructed yet.

### Conduit Hydroelectric Development

The Northwest Power and Conservation Council's Columbia River Basin Fish and Wildlife Program has designated certain river reaches as "protected areas," finding that new hydropower development in those areas would have unacceptable risks of loss to fish and wildlife.[4] Exemptions to this policy include adding hydroelectric facilities to already-existing non-hydroelectric dams or diversion structures.

Oregon has an expedited review process for proposed new hydroelectric projects at existing artificial delivery systems. The amount and timing of water diverted for an existing water use must remain unchanged (Oregon Revised Statutes 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 rights certificate will include requirements for fish screens, by-pass devices, and fish passage, with some exceptions.

In 2013, the Oregon Legislature passed Senate Bill 837, giving in-conduit hydro developers a choice: install fish passage as required by the Oregon Department of Fish and Wildlife or pay into a statewide fish passage account that will fund fish passage at priority locations identified by Fish and Wildlife.[5] The bill requires a review of this funding mechanism by October 1, 2018.

There are other projects generating electricity as water is injected into aquifer storage and recovery wells. Installed before the in-conduit rules described above, aquifer storage and recovery projects at Madison Farms of Echo and the City of Pendleton also represent a non-traditional use of hydroelectric power.

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

**Recommended Action 4.B**
**Take Advantage of Existing Infrastructure to Develop Non-Traditional Hydroelectric Power**

Examples of how to implement this action:

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

## Gain Water and Energy Savings

There are many options when selecting energy-efficiency and water efficiency techniques. Significant efficiencies could be realized from coordinating energy conservation and water conservation efforts.

### Saving Water and Energy at Wastewater Treatment Plants

Energy is needed to pump, treat, and deliver water to homes and businesses. For a municipality, the energy costs for managing water and wastewater can represent one-third of electricity costs. Oregon Association of Clean Water Agencies has actively partnered with its member agencies, providing training and best practices to drive down the use and cost of electricity in Oregon's wastewater treatment plants.[6] The association named the City of Gresham its outstanding member agency for 2015 for becoming a "net-zero energy" wastewater treatment plant. Gresham's activated sludge treatment plant generates all the power it needs to drive the wastewater plant through best-in-class energy conservation, a ground-mounted solar photovoltaic array, and co-generation engines driven in part by fats, oil, and grease collection. The City saves $500,000 annually on power bills, while generating $250,000 annually from fats, oil, and grease hauler tipping fees. Gresham is the first wastewater utility in the Pacific Northwest to reach net-zero energy status and one of only a handful in the United States.

### Saving Water and Energy through Building Codes

Building codes provide a basic starting point for water and energy savings in both residential and commercial buildings. Oregon has mandatory building codes in 11 different specialty areas, including plumbing (e.g., faucets, showerheads, urinals, and toilets) and residential energy efficiency (e.g., water heaters).[7]

To provide guidance to local jurisdictions on water conservation, the State of Oregon Building Codes Division approved Statewide Alternative Methods in 2008 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.[8] A few of these methods were updated in 2010. The Building Codes Division has also published a series of Oregon Smart Guides for consumers; two of those guides focus on rainwater harvesting and water conservation systems.[9]

The Division completed rulemaking on its Oregon Plumbing Specialty Code in October 2017. The new rules place a renewed emphasis on installing WaterSense® fixtures, such as low-flow or dual-flush toilets, and also updated the language around rainwater catchment systems.

### 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 13 gallons of water per load, compared to the 23 gallons used by a standard machine. Depending on use, this can result in a savings of 3,000 gallons of water per year.

Some utilities in Oregon offer incentives for installing ENERGY STAR appliances, some even offer incentives for premium water-heating technologies, such as tankless and heat pump water heaters, that help reduce the energy needed to heat water in the home.

As discussed in Chapter 4, water-saving appliances in the home include updated toilets, dishwashers, and washing machines, with faucet aerators and low-flow showerheads common as well.

### Saving Water and Energy in Agriculture

Pumping and moving water, especially groundwater, can require significant energy for agriculture and businesses. Agricultural producers are looking for ways to save on water and energy-related costs. The 2013 State of the Agriculture Industry Report by the Oregon Board of Agriculture describes an upward trend in the number of producers adopting changes that result in energy and cost savings.[10] Nearly 5,000 Oregon farms reported changes made in the previous five years to their equipment or management practices that reduced energy use or conserved water.

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 are some of the most popular types of multi-benefit projects. Farms often employ the use of efficient water application equipment, energy-saving pumps and motors, soil moisture monitoring programs, and precision fertilizer applications.

Achieving greater efficiencies in water application—for example, moving from gravity-powered systems to pumped systems—may simultaneously increase the demand for energy, driving up energy costs. This increased energy cost may outweigh the water-use efficiency benefits, and should be considered during the design of a project.

Grants and incentives are offered by the U.S. Department of Agriculture and Energy Trust of Oregon to encourage installation of more energy efficient irrigation and renewables. A variety of measures are supported by public utilities, including the installation of freeze-resistant stock watering tanks and low-energy precision irrigation equipment.

### Cross-Sector Coordination

Addressing the water-energy nexus cannot occur in isolation; the state must focus on cross-sector and cross-agency collaboration to develop solutions. Oregon's state agencies, working with their civic and industrial partners, should focus efforts on maximizing the efficient use of our water resources, particularly with respect to the generation of low-carbon electricity. Developing new partnerships between the water and energy sectors to better understand how energy is used in water services and how water is used in energy production is critically important.

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

Examples of how to implement this action:

- Move toward energy independence for publicly operated treatment works (wastewater treatment)
- Continue to implement and evaluate building codes that encourage water and energy efficiencies
- Encourage individuals, communities, industries, and businesses, including agriculture, to look for and integrate ways to conserve both energy and water
- Encourage cross-sector and cross-agency collaboration to achieve energy and water savings
- Strive to capture and publicly report energy and water savings data

**Highlight Box**

**Saving Water and Energy Go Hand in Hand**

Since 2009, WyEast RC&D Council has implemented a Save Water Save Energy program that supports agricultural water users across Oregon. Often times, water conservation projects in the agriculture sector can also save substantial amounts of energy. WyEast partners with extension specialists and other irrigation professionals to connect agricultural producers and rural small business owners to programs that offset the costs of making system upgrades or changing management practices. Some upgrades pay for themselves in a matter of years due to the energy savings and increased yields.

WyEast has been a leader throughout the region with helping irrigators find and adopt innovations in water and energy management. The orchards throughout the Columbia River Gorge have been early adopters of these technologies and management practices. With the combination of improved irrigation systems and soil moisture monitoring, some irrigators have seen water savings near 50 percent, all while the crop quality and yields have improved.

"We're only losing about 4 percent [of water] to wind drift and evaporation, which means a lot more water gets to the ground per gallon. We're saving water and saving energy."
– Troy Peters, Extension Irrigation Specialist

Find more information at: http://www.wyeast-rcd.org/

# Critical Issue – Climate Change

The statute directing the development of the Integrated Water Resources Strategy highlights climate change in several places. For instance, it calls for recommendations regarding continuous monitoring of climate change effects on Oregon's water supply, and for recommendations useful to water users. 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 availability, water rights, crop production, and migration patterns.

The consensus among global climate scientists is that climate change is occurring and that its impacts are already being felt. The *Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (IPCC) states that warming is undeniable, and since the 1950s many of the observed changes are unprecedented.

The IPCC further notes that continued emission of greenhouse gases will cause further warming and long-lasting changes throughout the climate system, increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystems.[11]

Increased air temperatures, changing precipitation patterns, and sea level rise all have potential consequences for Oregon's water resources; wetlands, estuaries, lakes, rivers, and streams, even groundwater. 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.

## Support Climate Change Research and Partnerships in Oregon

Many local, state, federal, and tribal governments are conducting climate change research, identifying and assessing risks and actions specific to the Pacific Northwest. Several of Oregon's drainage basins have been the focus of these latest research efforts, which will help water managers and natural resources agencies develop placed-based strategies for addressing climate-related impacts on water quality, water quantity, and ecosystems. Today, there are many opportunities to further collaboration between local partners, governments, and research institutions.

### Oregon Climate Change Research Institute

The Oregon Climate Change Research Institute (OCCRI) has been tasked by the Oregon Legislature to lead climate change research among faculty of the Oregon University System. In 2010, OCCRI released the first *Oregon Climate Assessment Report (OCAR)*, a compendium of research on climate change and its impacts on Oregon. The third edition of the OCAR was released in January 2017.

Researchers at OCCRI are examining climate change impacts on a regional scale, looking specifically at risks to the Pacific Northwest. The National Oceanic and Atmospheric Administration 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, 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 and has been home of the Regional Integrated Sciences and Assessments (RISA) for the Pacific Northwest since September 2010, one of ten RISAs in the country.

### Oregon's Climate Change Adaptation Framework

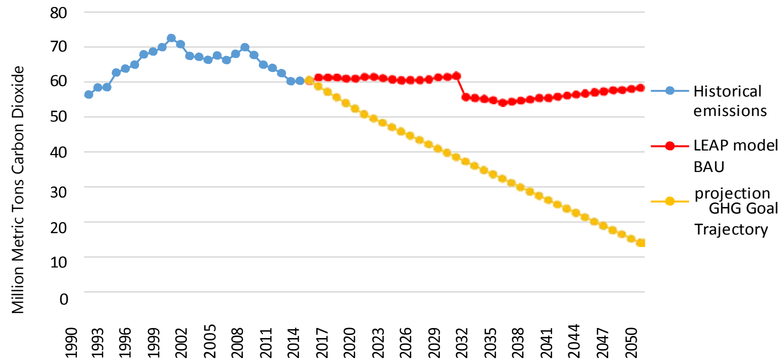
In 2010, the Oregon Department of Land Conservation and Development led an interagency effort to develop the *Climate Change Adaptation Framework* for the State of Oregon.[12] The Adaptation Framework provides a broad-scale qualitative assessment of risks to people, infrastructure, communities, and natural resources that are expected to result from the effects of variable and changing climate conditions. The Framework was developed in parallel with OCCRI's first *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 over the next three to five decades. The Adaptation Framework was used to guide a series of workshops on the north coast, where participants discussed climate projections and associated risks specific to their place. This proof-of-concept project was meant to align various climate change adaptation efforts. A regional framework was co-developed by participants, with support from Oregon Sea Grant and the Department of Land Conservation and Development.[13]

### Oregon Global Warming Commission

In 2007, the Oregon Legislature, through passage of House Bill 3543, established the goal of reducing greenhouse gas emissions by 10 percent below 1990 levels by the year 2020.[14] By 2050, those emissions have to be at least 75 percent below 1990 levels. That legislation also created the Oregon Global Warming Commission, which is tracking progress towards the goal. In 2013, Oregon agencies compiled a comprehensive inventory that utilizes data reported directly to the state via the Oregon Greenhouse Gas Reporting Program. In its 2017 Biennial Report to the Legislature, the Global Warming Commission noted that Oregon's greenhouse gas goals are not likely to be met with existing and planned actions.

The Report says that the largest part of Oregon's greenhouse gas emissions is not from energy utilities, but from the transportation sector. The Global Warming Commission says the decline in Oregon's diesel and gas emissions ended around 2015. The increase in transportation emissions since then is attributed to stagnant vehicle fuel efficiency and a rise in miles traveled by Oregonians.

**Figure 3-2: Projection of Greenhouse Gas Emissions**




A model, called "Long-range Energy Alternatives Planning," was developed for the purpose of conducting long-term energy and greenhouse gas forecasts and associated scenarios. The Global Warming Commission is using the forecast to show the direction the state's emissions are headed, absent of additional policy intervention (see Figure 3-2).

Despite the anticipated reductions resulting from Oregon's renewable portfolio standard and other policies, the state's emissions are not expected to come within striking distance of either the statutorily mandated 2020 and 2050 emission reduction goals, or the 2035 interim goal of being 40 percent below 1990 levels, as proposed by the Global Warming Commission.[15]

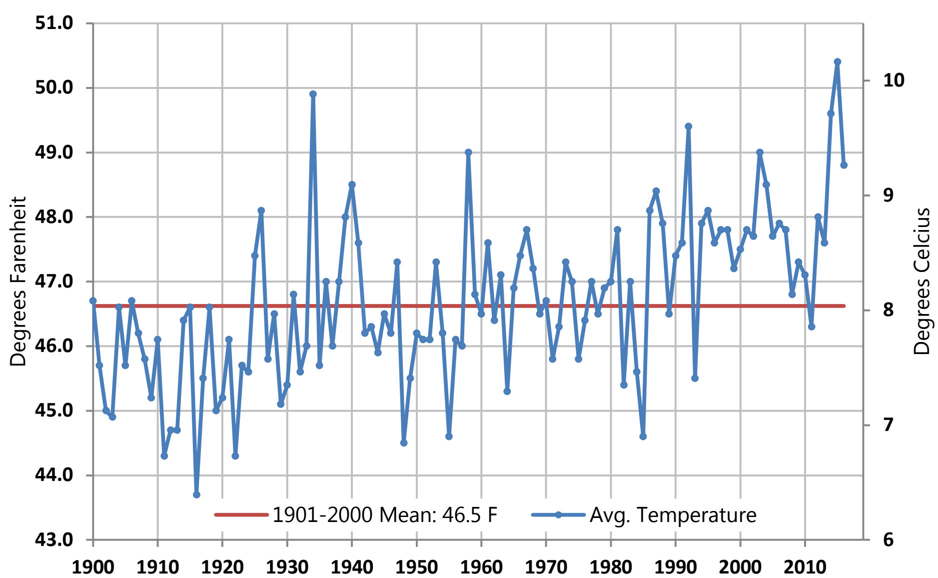
## Climate Change Projections for Oregon

Changes in climate are already visible in Oregon. Increasing temperatures are affecting the form of precipitation, and therefore Oregon's mountain snowpack. This is altering the timing, duration, volume, and quality of water runoff throughout the state. The following is a summary of some of the impacts and risks identified in the *Climate Change Adaptation Framework*, OCCRI's *Assessment*, and other recent studies.

### Increasing Air Temperature

Oregon's mean temperature has warmed by 2.2 degrees Fahrenheit since 1895, with the warmest year on record in 2015.[16] Under a scenario of continued increasing greenhouse gas emissions, Oregon's climate is projected to warm on average 3–7 degrees Fahrenheit by the 2050s. If global greenhouse gas emissions level off by mid-century, warming would be limited to 2–5 degrees Fahrenheit by the 2050s.[17]

**Figure 3-3: Oregon's Average Temperature, January to December**
based on NOAA weather data from 1901 to 2016

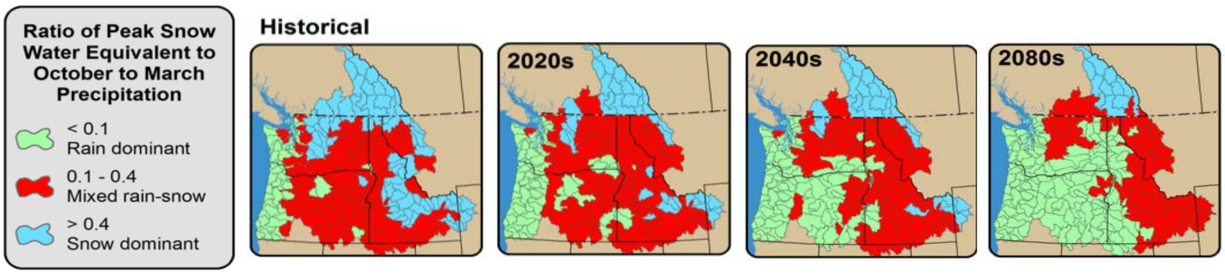


Annual precipitation is projected to increase slightly, although with a high degree of uncertainty. Summers are expected to warm more than the annual average and are likely to become drier. Extreme heat and precipitation events are expected to become more frequent.

## Declining Winter Snowpack

As mean annual temperature increases, the percentage of precipitation that falls as rain instead of snow will increase. Oregon is classified as 75 percent mixed-rain-and-snow for the twentieth century climate. By the 2080s, all of Oregon, except for parts of the Blue Mountains, is projected to become rain-dominant (Figure 3-4). [18]

**Figure 3-4: Changes in Snowpack from 2020 -2080 (A1B Emissions Scenario)**

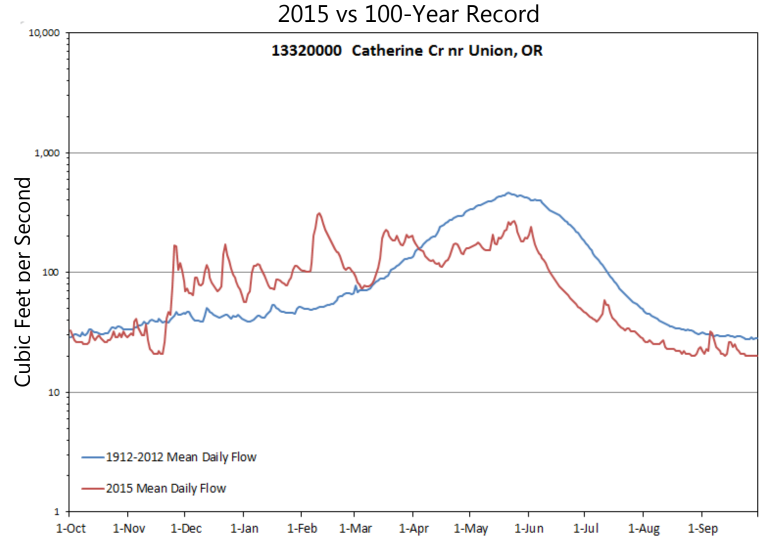



*Source: Hamlet, et al., 2013*

Precipitation that arrives as rain instead of snow runs off the landscape sooner, reducing groundwater recharge and streamflow in the late spring and summer. Hydrologic models project that by mid-century the peak runoff from snowmelt will occur three to four weeks earlier than the current average across the Pacific Northwest.[19]

An example hydrograph in Figure 3-5 from Catherine Creek near the City of Union is representative of the hydrologic conditions experienced during 2015, a record-low snowpack year for Oregon. Peak run-off for Catherine Creek usually occurs around the beginning of June at a rate of 7,000 cubic feet per second (blue line). Under warmer winter temperatures, precipitation arrived as rain instead of snow. Flows entering Catherine Creek peaked in February and waned long before the end of the growing season (red line).

**Figure 3-5: Mean Daily Flow in Catherine Creek**
2015 vs 100-Year Record




Without snowpack providing natural storage, Oregon will be less able to meet instream and out-of-stream needs during the summer and fall months, when demands are often greatest.

Storing water, via built and natural systems, will be an important tool to meet 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.

## Decreasing Water Quality

High water temperatures are already a major water quality concern in more than 16,000 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 lacking. A decline in summer streamflow will exacerbate the increase in water temperature, because low volumes of water can heat up more quickly than larger, faster streamflows. Although very few studies have been conducted to directly link harmful algae blooms to climate change, earlier or longer lasting blooms may be expected under warmer conditions in the future.

In snowmelt-dominated watersheds, an earlier occurrence of peak streamflow and snowmelt in the spring will result in decreased summer and fall flows, warmer summer water temperatures, and increased sedimentation, all of which have negative consequences for natural systems, salmonids and other estuarine and marine populations.

## Impacts to Coastal Systems

The coast is already vulnerable to a number of hazards, and these will be further exacerbated by climate-related impacts. Winter storms have historically been the primary factor for coastal erosion and flooding. The combination of increasing wave heights and rising sea-levels presents a substantial threat to the Oregon coast. Such threats include increased erosion and the loss of some beaches and coastal lands.

Sea-level rise will also have impacts beyond the coast, affecting tidally-influenced rivers and surrounding inland communities, where rising river levels can pose flooding problems. Other threats include increasingly stressed infrastructure built under older engineering standards. Infrastructure at risk can include water treatment plants, diversion facilities, and wastewater plants. The intrusion of salt water will pose a risk in some communities.

The Oregon Coastal Management Program at the Department of Land Conservation and Development is leading an ongoing project to inventory various assets, such as water infrastructure, that is most likely to be affected by sea level rise in 21 of Oregon's estuaries. The project will help prioritize areas to focus future resources and further study. Thus far, when considering sea level rise projections for 2030, 2050, and 2100, four municipal water intakes and eight wastewater treatment plants are potentially at risk to future flooding.

This exposure inventory project represents the first step in sea-level rise adaptation planning. Once completed, the inventories will be made available on the Oregon Coastal Atlas, an online depot of spatial analysis tools, planning, and other datasets for coastal systems.

## Impacts to Groundwater Systems

The 2017 Oregon Climate Assessment Report notes that, across the west, reduced snowpack is expected to result in declines in mountain groundwater recharge, affecting aquifers that are recharged from mountain systems. The timing of groundwater discharge to streams may also shift, possibly reducing baseflows in the late summer months. Much of this change largely depends on the hydrogeologic setting and a stream's sensitivity to climate change.

This decrease in groundwater supply becomes evident later in the water year when water users place greater demands on the resource. Longer and drier growing seasons generally result in an increased demand on groundwater and increased consumption of water for irrigation. With a rise in temperature of approximately 1.8 degrees Fahrenheit, irrigation demands are projected to increase by at least 10 percent in arid and semi-arid regions, translating into higher pumping and energy costs.[20]

## Impacts to Wetlands & Forests

Sufficient scientific evidence suggests that climate change is now having and will have significant impacts on coastal, estuarine, and freshwater wetlands. Sea-level rise and ocean acidification will likely affect tidal wetland habitats and the species they support. Wetlands can be sensitive to small changes in precipitation and temperature. These climate-sensitive habitats, including vernal pools, springs, and seeps support a variety of unique species, including threatened and endangered species.

Higher summer temperatures and earlier spring snowmelt are expected to increase the risk of forest fires. In the Pacific Northwest, the length of fire season has increased from 23 days in the 1970s to 116 days in the 2000s.[21] An increase of insect outbreaks, wildfires, erosion, and changing species composition in forests will pose challenges for ecosystems and significant challenges for water management.

### Impacts to Aquatic Species & Habitat

Changes in hydrologic regimes, such as the timing and extent of streamflow, have been observed in recent historical data and are expected to alter key habitat conditions for salmon and other anadromous fish that depend on specific conditions for spawning and migration.[22]

For example, increased winter and early-spring streamflows have the potential to scour eggs or wash away newly emerged fry of fall-spawning salmon and trout species. Extreme low summer streamflows can limit the accessibility for some species to move upstream to spawn. The impacts of climate change on the region's salmonids will vary across the region and among different species, populations, life-stages, and site characteristics.[23]

### Impacts to Human Health

The Oregon Health Authority published its 2017 Oregon Climate and Health Resilience Plan to alert Oregonians to the risks associated with a warming climate and building climate resilience.[24] With regard to water, the *Plan* notes that human health could be compromised by both drought and increased water temperatures, leading to conditions that result in harmful algal blooms and waterborne diseases. At the other end of the spectrum, flooding conditions caused by rapid run-off and increased precipitation can overwhelm drinking water intakes and sewer/wastewater systems alike.

### Impacts to Population Growth and Shifts

Despite the risks outlined above, Oregon may be relatively well off compared to other areas of the country. A number of media and academic reports have focused on the concept of "climate refugees" or "climate migrants," referring to those seeking more hospitable climates in the Pacific Northwest, compared to the hot and arid southwest. Researchers out of Portland State University and University of Washington Climate Impacts Group convened a symposium of experts in 2016 to debate not only the probability of this phenomenon but the impacts as well. They asked participants, "Do we need to be planning for more [population] growth in Washington and Oregon because of climate change, and if so, what would a systematic framework for developing and updating migration scenarios look like?"

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

Examples of how to implement this action:

- Make improvements in surface water and groundwater monitoring, flood and drought frequency projections, and long-range forecasts
- Improve climate change projections at a basin scale
- Develop reliable projections of basin-scale hydrology and associated impacts on built and natural systems, including aquatic species and habitat

Captured in a symposium document called, *Winds of Change? Exploring Climate Change-Driven Migration and Related Impacts in the Pacific Northwest*, participants clearly voiced a need to better understand if and how climate change-driven migration may affect existing assumptions about population growth in the region.[25] However, they generally felt it would be premature to make changes to current population forecasting models. Instead, they argued, researchers and decision-makers should work on identifying the additional information needed and should commit to expanding research and information around climate change-driven migration in the Northwest.

### Next Steps

Oregon should continue collaborating with existing climate change research organizations and institutions to improve climate change projections at a basin scale.  Basin-scale data are needed to help Oregonians prepare responses and strategies to address climate change.  These include: identifying basins susceptible to changing flow regimes, establishing gages to quantify the rate of change in the magnitude, frequency, duration, and timing of streamflow; identifying groundwater systems with areas of recharge within the rain-snow transition zone; monitoring groundwater level responses to climatic impacts; and working with the U.S. Geological Survey and other partners to support long-term, natural streamflow monitoring stations that have previously been used to assess climate impacts on water supplies (e.g., U.S. Geological Survey Hydro-Climatic Data Network stations, and Geospatial Attributes of Gages for Evaluating Streamflow stations).

## Assist with Climate Change Adaptation Strategies

Each summer, Oregon is water-short, with junior water users regulated in favor of senior water rights.  In the winter, communities will often experience flooding in neighborhoods, along rivers, and streams.  Climate change exacerbates the conditions at both ends of the scale—from drought and fire to heavy rain and snow.  In 2015 and 2016, Oregon sustained significant losses to crops, livestock, recreation, property and infrastructure, and species and habitat.  Extreme conditions are being felt across entire ecosystems.

These wide-ranging impacts mean that all sectors—public and private—must implement adaptation and resiliency strategies.

### Adaptation and Resiliency Strategies

Oregonians do know that a successful adaptation and resiliency portfolio will draw upon many of the water management and planning actions described in the 2017 Strategy.  The state needs to update its climate adaptation framework to strengthen efforts around climate resiliency strategies.  Convening a coordinating body of agency staff to collaborate on climate adaptation across sectors is needed.  Other states, for example, have created action teams to develop climate adaptation planning guides for local governments to assess vulnerabilities and develop strategies.  Climate adaptation can be supported by the following recommended actions:

- **Planning.**  Use existing planning processes to host these discussions and develop adaptation/resiliency strategies (Recommended Actions 9.A-C).

- **Research and Monitoring**. Climate change adaptation will require continued research and investments in climate monitoring and data mining, as well as a better understanding of changing needs and demands (Recommended Actions 1.A-1.C, 2.A, 3.A).

- **Education and Outreach**. Building climate resiliency will require active involvement of water users across all sectors. For example, improving methods around soil and tillage practices, and adjusting cropping patterns and crop selections may be needed in the future. Changing our practices will require not only more research, but targeted education and outreach efforts (Recommended Action 8.C).

- **Permitting.**  Permitting and zoning decisions play a significant role in climate change adaptation. Municipal, agricultural, forest, coastal and other lands play an important role as well.  (Recommended Actions 6.A-6.C).

- **Projects**.  Water efficiency (Recommended Action 10.A) and reuse projects (10.C) will stretch water supplies. Storage (10.B) will help with resiliency, much like having a multi-day supply of water in the home can bridge household needs during emergencies.  Non-traditional and market-based approaches may hold potential for adaptation that we have not even begun to realize (10.E). Likewise, protecting and restoring the health of streams, wetlands and floodplains, and improving riparian zones, uplands, and forests are efforts that should be continued, strengthened, and prioritized amongst private and public partners to improve ecological resiliency to climate change (11.A-11.D). Some of the techniques that may help with this work include protecting cold water refugia, ensuring floodplain connectivity, and protecting or restoring natural storage.

### Creating Resilient Water Utilities: An Industry Approach to Climate Adaptation

The change in runoff due to impervious areas has resulted in channelized and degraded streams. These urban impacts will be exacerbated by anticipated changes in rainfall patterns. Building resiliency in an urban environment can include use of green structures and low impact development, as well as stream restoration projects that can create more stable systems, retain water, and improve access to floodplains. These concepts are discussed later in the land use and water section.

Increased runoff, storm events, and sedimentation can greatly impair water and wastewater treatment facilities, causing them to be overwhelmed and taken off-line. When this happens, waterways experience increased pollution and communities experience higher treatment costs.

Over the years, the U.S. Environmental Protection Agency has created resources to help water providers develop and implement long-range climate adaptation options. Water sector utilities in Oregon should consider use of EPA's tools and guidebooks to prepare for climate change and extreme weather events. Utilities will need to ensure that they are capable of providing water and wastewater in the changing climate. This can be done by making water utilities more resilient— providing buffers, shoring up diversion, storage and transmission infrastructure, building in system redundancy (e.g., backup supplies, intergovernmental agreements), and further pursuing resiliency projects in partnership with neighboring communities.

### Water Rights and Climate Change

The shift 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. The implications of this could be particularly significant for water right holders who have historically relied on live flow surface water during the summer months.

In Oregon and throughout much of the west, states have adopted a series of court decrees and administrative rules that guide the timing of water withdrawals. "Irrigation seasons" are described in these documents, using specific dates. Prime growing conditions, however, are shifting to earlier in the year and have lasted longer, because of gradual changes in temperature. For example, some growers in the Willamette Valley that have their irrigation seasons defined on paper as April 1 through September 30 are experiencing growing conditions that could benefit from irrigation into the month of October. Other water rights have defined irrigation seasons of May 1 through September 30. In recent years, however, they have experienced growing conditions that could allow them to plant well before May. This increased demand for water in the early spring or late summer could happen more frequently in the future under a changing climate.

Irrigators and other water users may eventually find themselves holding legal documents – water rights – granting permission to use water during seasons that bear very little resemblance to the conditions taking place outside their windows.

Policymakers may one day have to revisit the body of rules that define irrigation seasons that were based on historic conditions. Although the process may take some time, the result could be a set of laws that align more closely with actual conditions in the field. States such as Oregon that have constructed laws in a sound manner with a strong scientific foundation have a good start. Making adjustments incrementally will be important for maintaining this strong foundation, while keeping up with a changing climate.

Similarly, 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. Future efforts should include an analysis of how instream and out-of-stream water rights would fare with significant hydrologic changes.

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

Examples of how to implement this action

- Provide technical support to communities to incorporate climate change impacts into their planning decisions
- Look for more efficient ways to conserve, store, and reuse water to benefit instream and out-of-stream uses
- Support ecosystem resiliency to climate change through habitat protection and restoration projects
- Analyze how instream and out-of-stream water rights will fare with hydrologic changes
- Promote use of the U.S. Environmental Protection Agency's current resources and tools for utilities

# Critical Issue – Extreme Events

Since the adoption of Oregon's first Strategy in 2012, the state has recorded its warmest year (2015), experienced the lowest snowpack on record (2015), had one of the most severe wildfire seasons and declared drought emergencies in 25 counties (2015), and was declared a major national disaster area by President Obama for damage cause by extreme storms, floods, and landslides in February 2016. Water year 2017 also proved to be a year of weather extremes for the Pacific Northwest. Portland, for example, experienced its fifth-coldest winter on record, with an average temperature of only 37 degrees. The dry conditions in May through July 2017 were the 5$^{th}$ warmest on record in the 123-year record, contributing to an intense wildlife season across the state.[26]

Recognizing that extreme weather events, such as drought, floods, and earthquakes occur at great cost to society, Oregon communities must prepare themselves for these natural hazards. The negative impacts of such events can be far-reaching and may exacerbate already existing water challenges, such as water scarcity, water quality, and instream habitat conditions.

In this document, we use the term "community" broadly to mean a group of people bound by a common geography, background, or interest. A community might concern itself with ecological and instream interests; it might also concern itself with human or economic needs. These concerns are not mutually exclusive and may overlap quite a bit. A community's vulnerabilities may differ by geography, water-use sectors, income, ability to access storage or additional water supplies, and other factors. Vulnerabilities might be lessened through improved forest health, wetland capacity, natural storage, and floodplain health.

Public, private, tribal, and non-profit organizations working together, as well as individuals who take personal responsibility for thorough preparation, will be critical for Oregon to withstand these extreme events. Key organizations will be those who can play roles in mitigation, communication, response, and recovery. Their work will be to design resiliency into community planning, determine which communities are vulnerable and how, and document the economic, social, environmental, and other impacts of such events.

The state for its part may need to facilitate innovation in adopting and implementing policies, procedures, regulations, and zoning that allow flexibility, while protecting human health, social systems, economic systems, the built environment, and natural systems.

## Build Drought Resiliency in Oregon

In July 2015, Governor Brown issued Executive Order 15-09 calling for several drought and climate-related actions.[27] Among these, state agencies were directed to build drought resiliency measures into the Integrated Water Resources Strategy. Oregon experienced severe-to-extreme drought across the entire state that year. For some communities, 2015 marked the third, or in some cases, the fourth year of continuous drought conditions. The drought not only affected Oregon, but the entire west coast.

Twenty-five of Oregon's 36 counties received a drought declaration from the Governor in 2015 – more than any other year since 1992.

In the case of severe or multi-year droughts, soil moisture does not recover in time for the next growing season. Groundwater levels do not rebound and refilling reservoirs can prove difficult. Because droughts are a slow-moving disaster where impacts develop over time, persisting even after the rain and snow returns, building drought resiliency in Oregon will require a portfolio of water management methods that are put into place long before the next drought arrives.

### Defining Drought

Precipitation and temperature are the main drivers of drought, and largely determine snowpack, soil moisture, and streamflow levels, which are commonly used as indicators of drought. In Oregon, many watersheds depend heavily on snowpack for annual water supply, and the timing of peak runoff from snowmelt is critical.

As noted in Oregon's 2016 *Drought Annex*, a drought response plan within the state's emergency operations plan, droughts can generally be characterized by an increased demand or decreased supply of water.[28] In the early 1980s, researchers with the National Drought Mitigation Center (NDMC) and the National Center for Atmospheric Research located more than 150 published definitions of drought. In order to simplify analysis, the NDMC now provides five different ways in which drought can be defined.

- **Meteorological Drought –** Meteorological droughts are usually defined on the basis of dryness, compared to some type of normal or average amount. Due to climatic differences, what might be considered drought in one location of the state may not be the same in a different location. The concept of a "snow drought" has emerged in recent years. Experiencing below average snowpack with above average precipitation, as was the case in 2015, has spurred the study of snow droughts.
- **Hydrological Drought –** This definition of drought describes a situation that occurs when surface and subsurface water supplies are below normal, caused by shortfalls in precipitation, including snow. A hydrological drought usually lags behind a meteorological or agricultural drought. Low precipitation takes longer to show up in streamflow and groundwater, for example.
- **Agricultural Drought –** An agricultural drought occurs when the amount of moisture in the soil no longer meets the needs of a particular crop. This type of drought links together the various characteristics of meteorological (or hydrological) drought to agricultural impacts.
- **Socioeconomic Drought –** This refers to the situation that occurs when physical water shortages begin to affect people and the supply of economic goods and services.
- **Ecological Drought –** A prolonged and widespread deficit in available water supplies — including changes in natural and managed hydrology — that create multiple stresses across ecosystems.

Drought is not an abnormal occurrence in Oregon, with notable droughts in the 1930s, 1976-77, 1992, 2001-02 and 2012-2015. In the future, Oregon might see dry winters with little precipitation and limited snowpack accumulation. Warm winters may also be common, with more precipitation falling as rain rather than as snow, leading to earlier runoff. One might also see dry summers, with little precipitation available during the driest months of the year.

High temperatures in the summer can exacerbate drought conditions, as increased temperatures can reduce soil moisture and increase rates of evaporation and evapotranspiration. These conditions can lead to limited water supply for livestock and crops, reduced irrigation deliveries, and poor yields. Warm summer temperatures can also cause changes in the timing of water supply and water quality issues (e.g., algae blooms and waterborne diseases).

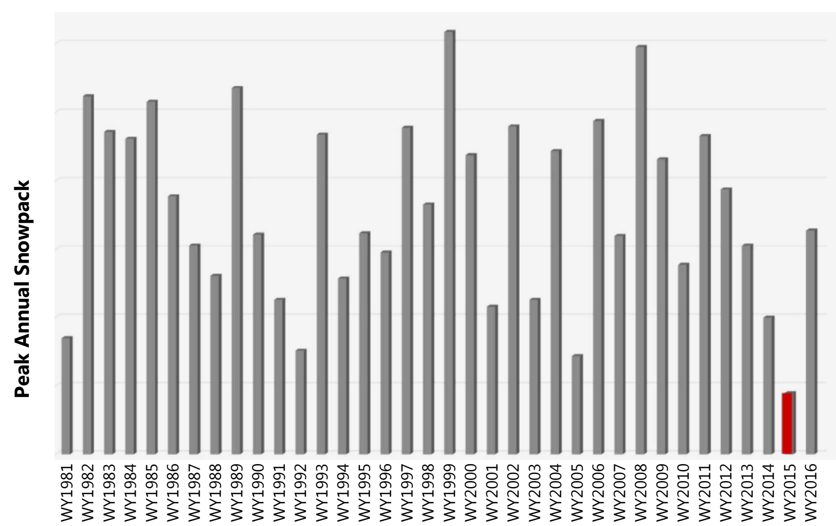
## Drought Conditions in 2015

Although winter precipitation amounts were relatively average during 2015, it was Oregon's warmest winter on record. January and June were the most unusually warm months for Oregon that year. The average temperature in January was 38.1°F (7.4°F warmer than the historic average) and the average temperature in June was 65.6°F (8.3°F warmer than the historic average). Oregon's statewide average temperature for the entire water year was 50.8°F (4.2°F warmer than the historic average).

The warm temperatures during the winter led to a dismal snowpack, the lowest on record since 1981 (see Figure 3-6). Most of the precipitation that fell came as rain, not snow. With continued warming, this type of snow-drought is expected to occur more often in the future.

Snow melted earlier than normal, and there was less continuous runoff available during the summer months. Severe conditions continued throughout the year, as the state also faced the warmest and driest summer on record.

**Figure 3-6: Oregon's Peak Annual Snowpack**
Water Years 1981-2016




The U.S. Drought Monitor, produced through a partnership between multiple entities, takes into account factors such as temperature and precipitation. It does not, however, adequately reflect soil moisture conditions, real-time snowmelt (run-off), or future forecasts. These missing variables are key pieces of information needed to understand near-term and short-term drought conditions. Oregon needs a better set of indicators that signal differing stages of drought and that can be used as a planning, communication, and response tool.

## Impacts and Responses to the 2015 Drought

The 2015 drought, and the dry conditions leading up to it from previous years, had varying impacts over time and across Oregon's regions, sectors, and economies. The Integrated Water Resources Strategy partner agencies held open houses and conducted an online survey to learn about how the drought affected communities across the state, and how people responded. Participants were also asked what actions should be pursued to better prepare for future droughts. Several thoughtful and useful strategies were suggested, making it clear that drought has impacts on every aspect of our way of life in Oregon.

**Fisheries Impacts –** There were several significant fish die-offs in 2015, including in the Willamette, Clackamas, John Day, and Deschutes Rivers and some hatcheries, where high water temperatures amplified the effects of a naturally occurring parasite called Ichthyophthirius (Ich) and a bacterial fish disease known as columnaris. Mortality caused by drought not only affects existing fish, but also may result in lower numbers of fish in future generations. Half of Oregon's hatcheries were affected by drought conditions in 2015.

The Department of Fish and Wildlife implemented a daily fishing curtailment regulation in nearly every stream in Oregon in 2015. This was the first time that a statewide curtailment was implemented. The daily curtailment began in mid-July in response to extremely high water temperatures and early season low water levels. Due to these extreme conditions, streams were closed daily to fishing for trout, salmon, steelhead, and sturgeon from 2:00 pm to one hour before sunrise. These closures were implemented to avoid any additional stress on fish from fishing activity.

**Drinking Water –** Communities responded to water shortages in 2015 in a number of ways. Several municipalities engaged in targeted water conservation and curtailment messaging to their customers to stretch water supplies. Some communities, like the City of Ashland, ramped up outreach efforts within their ongoing water conservation programs, which commonly provide financial rebates for residents who replace toilets, dishwashers, and washing machines with more efficient systems. The record low river flows caused by the drought led to water quality issues at some municipal intake structures as well.

**Recreation –** The drought also strained summer recreational activities, such as skiing, boating, fishing, and hunting, as well as the local economies that depend on visitors. Detroit Lake, for example, saw a 26 percent decline in visitors due to low water levels and inaccessible boat ramps.[29]

Winter recreational activities also felt the impact of a record-low snowpack. Mt. Ashland ski resort wasn't able to open during the 2014-15 ski season. Ski managers got creative, using snow-harvesting and other strategies to allow the resort to stay open in 2015-16.[30]

**Agricultural-Related Impacts –** Limited water supply and high temperatures damaged certain crops and reduced yields, and ranchers in multiple counties struggled with dry pastures and limited water for livestock. Heat-stressed cattle were fed supplemental rations to help provide necessary nutrients. Some ranchers shipped cattle to feedlots earlier than normal or weaned calves early, due to a lack of feed and water.[31]

Many irrigators planted fewer crops and left land idle, enabling them to use more of their water allotments on other plots. It has been estimated that eastern Oregon farms in Treasure Valley received a third of their normal irrigation water, due to low storage in Owyhee Reservoir[32]. Some farmers switched to different crops, planting higher value crops, such as onions and beets, or moving to lower value crops that require less irrigation, such as grain and seed crops. These management decisions are heavily dependent on both expected water supply and market prices.[33] Federal funding programs were made available to help recoup expenses from damage to crops or herds.

In some areas, the state's watermasters had to shut off irrigation for water right holders much earlier in the season than normal, shutting off more senior water right holders—some for the first time ever. Many growers were allocated less water than normal. Situations like these prevented some small farming operations from planting crops at all.[34]

**Wildfires –** Several state and federal agencies are involved in wildland fire suppression in Oregon. The 2015 fire season for the Pacific Northwest was notable for its severity and cost. The U.S. Department of Agriculture reports that more than 630,000 acres burned in Oregon during the fire season and characterized 2015 as the "most severe in modern history from a variety of standpoints."[35]

The Oregon Department of Forestry estimates that large-fire costs for state agencies amounted to $94.4 million, more than $70 million in additional expenses compared to the 10-year average of $22.3 million.[36]

**Lessons Learned from Drought 2015 –** Documenting drought conditions, especially its impacts on people and the environment, is an important component of understanding and preparing for future droughts. Using drought emergency relief funds approved by the Washington Legislature, the state of Washington recently completed an economic assessment that quantifies the impacts of the 2015 drought on the state's farmers and ranchers, an effort that had not previously been done at the statewide level.[37] Oregon does not have the resources to conduct a thorough analysis of drought's impact to various sectors. Today, most impact-related data is collected anecdotally. The state should invest in ways to track and quantify the effects of drought and assist the most vulnerable communities.

Any drought assessment should also include a summary of drought frequency, distribution, intensity, and duration. Doing so is critical, especially as climate projections indicate that the Pacific Northwest will more regularly experience warmer temperatures.

## A Closer Look at Drought Declarations

County-wide drought declarations go through a two-part process before securing a drought declaration from the Governor. First, County Commissions meet to determine whether they need to request a Governor's declaration. Then these requests go to the Drought Readiness Council (co-chaired by the Office of Emergency Management and Water Resources Department) for review and recommendation to the Governor.

The Governor can issue an Executive Order to declare drought—either independently or in response to a request by counties. In recent years, these Executive Orders have been set to expire at the end of a calendar year.

A Governor's drought declaration can trigger a number of requirements and water management tools not otherwise accessible. Declarations allow the Water Resources Commission to grant a temporary preference of use of water for human consumption and/or stock watering. Drought declarations also authorize the Water Resources Commission and Governor to require state agencies and local governments to develop and file water conservation and/or curtailment plans; the Governor may require the implementation of such plans. Finally, declarations allow the Water Resources Department to use an expedited process in a number of water right areas, including the issuance of emergency drought permits for groundwater.

Emergency drought permits are the most frequently used tool in the state's drought toolbox. During the past five years, the state has issued almost 90 emergency drought permits for groundwater use. Eighty of those were in the Klamath basin. During the same time period, the state approved more than 40 emergency drought transfers. Of these, eight were in Klamath County, seven were in Malheur County, seven were in Baker County, and six were in Lane County. The state must find that allocation is within the capacity of the groundwater resource in order to approve these requests; this protects existing water users. That is why some irrigators do not apply in the first place, or some emergency drought applications are not approved.

Communities and businesses looking to offset drought-related losses often turn to the federal government, which can provide payments or emergency loans after a federally-issued drought disaster designation by the Secretary of Agriculture. Federal drought funds generally cannot cover all losses suffered by producers, but they can help.

## Improving the Drought Toolbox

In 2016, the Oregon Legislature established a Drought Task Force to develop recommendations that could help improve the state's response to drought.[38] A number of the Drought Task Force recommendations also resonated with the 2016 IWRS Policy Advisory Group, which confirmed several of these in its final report.[39] Both groups called on the state to:

- Continue to increase and enrich water-related data collection to inform water use decisions, conservation, and management, as well as better anticipate and respond to drought.
- Provide resources for assessments of drought impacts, risks, and vulnerabilities on instream and out-of-stream sectors in order to better prepare for, respond to, and recover from drought.
- Provide OWRD with staff resources to do outreach and communication. Develop a communication tool box to educate all sectors and elected officials about existing tools, water conservation, drought conditions and preparedness, and help small communities respond to drought.
- Provide funding for additional watermaster staff and tools to make water distribution more efficient.
- Consider additional programs to facilitate restoration of streamflows through voluntary means during times of drought.

Some of these recommendations have broader implications than drought and are discussed in other chapters of the Integrated Water Resources Strategy; drought-specific recommendations are summarized at the end of this section.

The Drought Readiness Council, mentioned earlier, is a standing body comprised of federal and state natural resource, public health, and emergency response agencies. During a drought, the Council reviews local requests for assistance and makes recommendations to the Governor. The Council has taken a look at the drought toolbox to determine what improvements, if any, can be made at the state level. In the wake of a governor-declared drought, the Drought Readiness Council sees four potential opportunities for response at the state level:

1) **Providing Emergency Funds.** Some water managers have found that intake pipes no longer extend far enough into the stream, that pumps no longer reach water down into a well, that saline water is infiltrating water systems, and that other infrastructure is similarly inadequate. Drought has ecological effects as well, drying up reaches, stranding fish, and warming cold water refugia, for example. Emergency funding, if made available, could help address these problems and should be used to create more resilient human and ecological communities.

2) **Improving Communication through Outreach and Education**. Communication with Oregonians should not be triggered by a drought declaration, but should be in practice long before drought conditions turn severe. Outreach and education are long-term tools and resources that must in place as part of agencies' day-to-day operations. Agencies should increase awareness around drought and share best management practices. Increasing agency capacity for outreach and education is secured through the budgeting process, which agencies prepare for each biennium.

3) **Developing Drought Contingency Plans**. These plans spell out what measures water providers or individual users will undertake during times of water shortage. They help lay out conservation, storage, curtailment, and communication priorities. These plans can be voluntary, and even developed collaboratively at a basin or watershed scale among different users and interests. After a drought declaration, however, the Governor or Water Resources Commission can require state agencies or public entities, such as a city or district, to develop

such a plan. The Governor may then also require water users to implement these plans. In 2015, for example, the Governor directed state agencies to develop and implement such plans. Immediate responses from the agencies included: water-use measurement and reporting, water efficiency projects, repairs to leaky pipes, and curtailment of ornamental fountains.

4) **Creating Mandatory and Voluntary Measures.** The Water Resources Commission and Governor already have the statutory authority to give priority for water to human health and livestock in times of drought. The Governor also has broad discretionary emergency authorities. The Department of Fish and Wildlife currently utilizes a variety of strategies and actions to minimize the negative effects on fish and fisheries due to impacts from drought. These strategies include partially or completely closing a fishery or area during a portion of the day or season, or encouraging anglers to voluntarily reduce fishing when water temperatures and flows are significantly outside the normal range for a certain time of the year. Additional voluntary measures could help conserve water as well as protect streamflows during times of drought. The Department of Fish and Wildlife is interested in exploring further with its partner agencies and stakeholders how other states have used voluntary, regulatory, and funding programs to ensure minimum streamflows during drought.

## Planning for Future Droughts

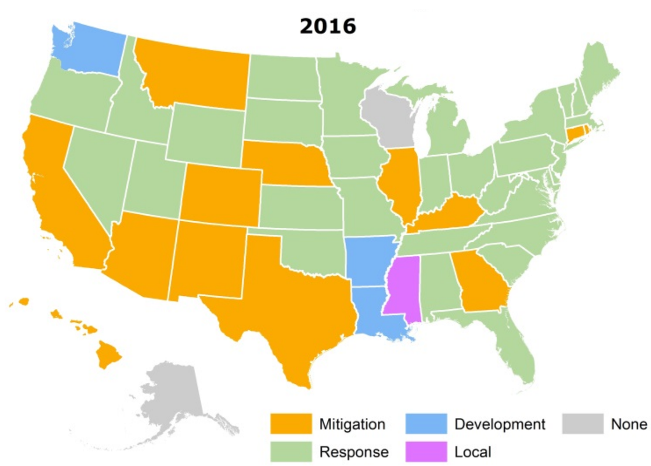
A study by the Multi-Hazard Mitigation Council shows that each dollar spent on mitigation saves an average of four dollars overall.[40] Planning ahead is generally seen as more efficient and more effective than actions taken during a drought.

Drought is one of eleven natural hazards discussed in the state's 2015 Natural Hazards Mitigation Plan.[41] Each hazard is analyzed statewide and at a regional level. The plan contains mitigation actions, which are meant to reduce or eliminate the long-term risk to people and property from hazards. Hazard mitigation, in general, is the responsibility of individuals, industry, and government. Local governments, such as cities and counties, often develop their own multi-hazard mitigation plan.

Oregon's Natural Hazards Mitigation Plan is a component of the state's Emergency Operations Plan (EOP). In addition to preparedness and mitigation, the EOP addresses emergency operations, as well as relief and recovery efforts. In early 2016, the Water Resources Department and the Office of Emergency Management updated Oregon's incident annex on drought, which is largely a response plan for state agency coordination activities.

Most states focus solely on development of a mitigation or response plan for drought (see Figure 3-7). Rarely do you see integrated mitigation and response plans.

**Figure 3-7: Status of State Drought Plans**




Source: National Drought Mitigation Center

A response plan focuses on short-term actions to help reduce the immediate impact of drought, whereas mitigation plans tend to address actions taken before a drought occurs in order to reduce potential future drought impacts.

Since the late 1980s, Oregon has spent most of its focus on response planning and related activities. Several states, including California, are focusing more closely on mitigation planning efforts. The state of Colorado has a combined *Drought Mitigation and Response Plan*[42], which provides a thoughtful working model for other states that are developing their own vision of drought resiliency.

**Drought Early Warning System –** The National Integrated Drought Information System is a program authorized by Congress in 2006 to coordinate and integrate drought research and create a national drought early warning information system.

Regional early warning systems have been developed through partnerships with other federal, state, regional, local and private entities with the goal of helping stakeholders in the region cope with drought.

These systems explore and demonstrate a variety of early warning and drought risk reduction strategies that incorporate drought monitoring and prediction information. The Pacific Northwest Drought Early Warning System launched in February 2016 includes Idaho, Oregon, Washington, the western portion of Montana that feeds into the Columbia River Basin, and British Columbia. Oregon representatives are participating in this group to learn about how other states in the Pacific Northwest are collecting drought-related information and using that to design drought plans, resiliency actions, and guide policy development.

**Recommended Action 5.5A**
**Plan and Prepare for Drought Resiliency**

Examples of how to implement this action:

- Assess and assist those communities and ecosystems most vulnerable to drought
- Develop the appropriate set of indicators that signal and forecast differing stages of drought
- Document the economic, social, and environmental impacts of drought, including the frequency, distribution, intensity and duration
- Prepare for, respond to, and mitigate for the impacts of drought
- Improve the drought toolbox, through education and outreach, drought contingency plans, more efficient water distribution systems, additional voluntary measures to improve streamflow, and emergency funding that increases resiliency

## Plan and Prepare for Flood Events

This section focuses on the public safety and emergency nature of flooding. Floodplain protection and restoration is discussed under the topics "water and land use" and "healthy ecosystems."

Oregon's mountain ranges are part of the reason there is tremendous variation in the types of flooding we experience. Although floods are a common natural hazard in Oregon, floods west of the Cascades tend to be large-scale events, while eastern Oregon typically experiences more localized, intensive events. The four types of flooding described in the 2015 Natural Hazard Mitigation Plan include:

**Riverine flooding –** The most common flood hazard in Oregon and usually occurs during winter. The most severe flooding conditions occur in "rain on snow" events, when heavy rainfall is augmented by rapid snowmelt. Longer duration storms and floods are more common in western Oregon. Very large and widespread floods occurred in parts of western Oregon in 1861, 1891, 1948, 1964, 1996 (three separate storms), and 2007.

**Flash flooding –** Flash floods are caused by extremely intense rainfall over a short period of time, commonly within a single drainage. Such events usually occur in the summer during the thunderstorm season. In eastern Oregon, local convective thunderstorms often produce the most severe flooding. One of the worst flash floods in history occurred in eastern Oregon in June 1903, killing 247 people (one-fifth of the population at the time) in the town of Heppner.[43]

**Coastal flooding –** Coastal floods result from different conditions. Winds generated by tropical storms or intense off shore low-pressure systems can drive ocean water inland, causing significant flooding.

**Urban flooding –** Urban floods occur because land is converted from fields or woodlands to roads, roofs, and parking lots, losing its ability to absorb rainfall. This transition from pervious surfaces to impervious surfaces results in more and faster runoff of water. During periods of urban flooding, streets can become swift moving rivers, and basements can fill with water. Storm drains may back up with yard waste, causing additional nuisance flooding.

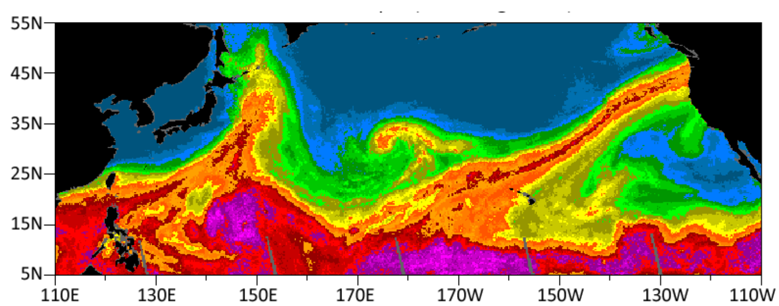
## Atmospheric Rivers

Atmospheric rivers are relatively long, narrow regions in the atmosphere – like rivers in the sky – that transport water vapor from the tropics. These columns of vapor move with the weather, capable of carrying an amount of water that exceeds the flow at the mouth of the Mississippi River. When atmospheric rivers make landfall, they often release this water vapor in the form of rain or snow. Although atmospheric rivers come in many shapes and sizes, those that contain the largest amounts of water vapor and the strongest winds can bring extreme rain and floods, often by stalling over watersheds vulnerable to flooding. These events can disrupt travel, induce mudslides and cause catastrophic damage to life and property.[44]

Atmospheric river events sometimes result in extreme precipitation events west of the Cascade Range, or isolated events east of the Cascade Range. Each year, roughly 30 percent of Oregon's winter precipitation falls in heavy, typically atmospheric river–fueled precipitation events.[45]

The Pacific Northwest regularly experiences storms caused by atmospheric rivers. In early November 2006, an atmospheric river event affected western Washington and northern Oregon, producing heavy rainfall and devastating flooding and debris flows with damages exceeding $50 million.[46] (See Figure 3-8).

**Figure 3-8: November 2006 Atmospheric River Event**




Source: NOAA Earth System Research Laboratory

## Understanding Oregon's Flood Risk

Similar to drought, Oregon should develop indicators of flood emergency stages that can be used as a planning, communication, and response tool. Oregon does not have a consolidated assessment of past floods and their economic, social, and environmental impact. Oregon should research how changes in land use, land cover, forest cover, and watersheds—including upstream impervious surfaces, geomorphology, logging, and forest fires—may change the location, strength or duration of floods, flood ways, and flood discharge. This information could be beneficial to local planning efforts.

Our understanding of flood risk in Oregon is limited, compared to other regions of the country. However, we do know with reasonably high confidence that the frequency of extreme precipitation and flooding events are likely to increase around the state under a warming climate. Oregon is one of only five states that lack up-to-date precipitation-frequency analysis prepared by the National Weather Service. Oregon also does not have a reliable extreme maximum flood document, which most other states have.

Uncertainty in precipitation information coupled with climate change and possibly more extreme precipitation events has significant implications for the safety of water resources infrastructure. The design of dams, wastewater facilities, bridges, and culverts depends on accurate precipitation estimates for extreme events.

The National Weather Service can update precipitation frequency estimates if it receives funding for such work. Oregon now relies mostly on information from 1973, with a very partial update completed in 2008. An analysis of precipitation frequency information with resulting maps and tables would provide designers and operators of water infrastructure with the most current and reliable precipitation frequency estimates to withstand floods.

Engineers need reliable information to design safe infrastructure. Agencies that have expressed support for this research include the U.S. Army Corps of Engineers, the Natural Resources Conservation Service, the Oregon Department of Agriculture, Department of Environmental Quality, Office of Emergency Management, Oregon Health Authority, and the Water Resources Department. Despite this, the project to provide current precipitation return frequency information is not yet sufficiently funded. Without better information, infrastructure is more likely to fail during a major flood and as a result, imperil public safety and property.

Where forest fires have burned and changed land cover, updated precipitation frequency information can be used in hydrologic models to predict new flows in the watershed. After a wildfire, the charred ground repels rainwater, increasing the risk of flooding and debris flows for several years. The intense storms that follow can lead to severe flooding and landslides. In light of recent drought and ensuing wildfires, state emergency managers recognize the need to be able to respond to these environmental stressors rapidly and responsibly. Installing traditional stream monitoring equipment is one option, although it can be expensive and time consuming to set up and maintain. By contrast, temporary, real-time, rapid-deployment equipment can be set up and removed quickly for early warning purposes.

### The Need for Inter-Agency Coordination

Dealing with floods and the potential for landslides requires inter-agency partnerships across multiple jurisdictions. Silver Jackets is a group of local, state, federal and tribal agencies chaired by the U.S. Army Corps of Engineers and is focused on reducing the risk of flooding and other natural disasters. Most states have a Silver Jackets program, and Oregon's program focuses on flood preparedness, communication, and recovery. While much work still remains to get adequate policies and programs in place, the group has recently launched a new website containing information and resources for use before, during, and after a flood.

The state also leads a Flood Core Team focused specifically on updating the flood-related portion of Oregon's Emergency Operations Annex.

**Recommended Action 5.5B**
**Plan and Prepare for Flood Events**

Examples of how to implement this action:

- Develop indicators of flood emergency stages, using information about meteorologic, hydrologic, hydraulic, and watershed conditions
- Document the economic, social, and environmental impacts of floods
- Evaluate potential for extreme flooding, under atmospheric rivers and climate change scenarios
- Establish early flood warning systems in areas where recent drought and wildfire have affected forests and vegetation

# Plan and Prepare for a Cascadia Earthquake and Tsunami

Seismic activity in the state has been relatively low since the time of European settlement. Up until the mid-1980s, Oregon was not considered to be at high earthquake risk. Infrastructure built before 1980 was designed with criteria based on that seismic understanding. During the past 25 years, however, geological analyses have led to a very different understanding of seismic risk in Oregon.

## Earthquakes and Tsunamis in Oregon

The Oregon Department of Geology and Mineral Industries (DOGAMI) is the lead agency for earthquake hazards. DOGAMI has created maps that identify areas in selected Oregon communities that will suffer more damage, relative to other areas, during a damaging earthquake. A clearinghouse of tsunami information is also maintained by DOGAMI and includes information for coastal residents, visitors, planners, and scientists.

There are two major types of earthquakes that occur in Oregon: megathrust earthquakes that occur along the Cascadia Subduction Zone near the coast, and smaller crustal earthquakes. For the most part, crustal earthquakes occur on shore on much smaller fault systems. The two largest earthquakes in recent years occurred in Scotts Mills (magnitude 5.6) during 1993 spring break and six months later in Klamath Falls (magnitude 5.9 and magnitude 6.0), both of which were crustal earthquakes. The last major subduction zone (megathrust) earthquake and tsunami occurred more than 300 years ago in 1700.

## A Cascadia Earthquake

The Cascadia Subduction Zone fault, shown in Figure 3-9, spans from Northern California to southern British Columbia and can produce earthquakes as large as magnitude 9.0 with corresponding tsunamis. Scientific evidence indicates that an earthquake of this size occurs along the fault on average once every 200 to 500 years.

The Cascadia Subduction Zone closely mirrors the subduction zone in northern Japan that produced the 2011 Tohoku earthquake. The incredibly destructive tsunami that resulted from the Tohoku earthquake should serve as a warning to Oregon.

When a Cascadia earthquake occurs, it will affect mostly western Oregon, and in particular, coastal communities. Following such an event, it is estimated that it will take one to three years to restore drinking water and sewer services in the coastal zone.

**Figure 3-9: Cascadia Subduction Zone**

Source: Adapted from FEMA

Available studies estimate that a Cascadia earthquake and resulting tsunami could result in 1,250 to more than 10,000 fatalities, tens of thousands of buildings destroyed or damaged so extensively that they will require months to years of repair work, tens of thousands of displaced households, more than $30 billion in direct and indirect economic losses (close to one-fifth of Oregon's gross state product), and more than one million truckloads of debris.[47]

### 2013 Oregon Resilience Plan

In 2013, the Oregon Seismic Safety Policy Advisory Commission published the Oregon Resilience Plan describing likely outcomes from a Cascadia Subduction Zone earthquake event. The plan notes:

> It is simply not scientifically feasible to predict, or even estimate, when the next Cascadia earthquake will occur, but the calculated odds that a Cascadia earthquake will occur in the next 50 years range from 7 to 15 percent for a great (magnitude of 8.7 to 9.3) earthquake affecting the entire Pacific Northwest to about 37 percent for a very large (magnitude of 8.3 to 8.6) earthquake affecting southern Oregon and northern California. The likelihood of a magnitude 9.0 Cascadia earthquake during our lifetimes and the consequences of such an earthquake are both so great that it is prudent to consider this type of earthquake when designing new structures or retrofit of existing structures, evaluating the seismic safety of existing structures, or planning emergency response and preparedness.

The Oregon Resilience Plan encompasses a set of short- and long-term recommendations regarding critical and essential structures, transportation, energy, information and communication, and water and wastewater systems. The plan notes that, "The scientific understanding of the Cascadia threat makes it clear that very large earthquakes will occur in Oregon's future, and that our societal and physical structures are poorly prepared to meet the threat unless we take action now to start building the necessary resilience."

The plan further notes that "Oregon's water and wastewater systems are especially vulnerable to damage resulting from a Cascadia subduction zone earthquake." With seismic activity including liquefaction, lateral spreading, landslides, shaking, and tsunami inundation, the vulnerabilities of water and wastewater systems are significant. The Oregon Seismic Safety Policy Advisory Commission made several recommendations to address these vulnerabilities and build the resiliency of water and wastewater systems, which are summarized below.

**2013 Oregon Resilience Plan | Summary of Recommendations from the Water and Wastewater Chapter:**

- Begin aggressive public information efforts to re-set public expectations for a realistic response time. The old guideline of having a 72-hour emergency survival kit falls far short.
- Public agencies should be advised that the Oregon Water/Wastewater Agency Response Network is a vital resource and membership is recommended.
- Service providers from all sectors should be required to have a business continuity and seismic response plan that includes resources normally provided by functioning infrastructure (e.g., food, water, and communications).
- Service providers should plan for and support employee preparedness.
- Water-related industry associations and manufacturers should evaluate the need for seismic design standards for pipelines.
- Seismic vulnerability criteria should be incorporated into overall capital improvement project planning and asset management priorities, particularly updates to water system master plans.
- The Oregon Health Authority should be encouraged to include a seismic design requirement as part of routine design review of water system improvements.
- Encourage the Oregon Department of Environmental Quality and the Oregon Health Authority to establish goals and expectations for post-earthquake regulatory compliance and applicable standards. For example, will it be acceptable to discharge into waters of the state the chlorinated water from main breaks and main repairs?
- Encourage public health, water, and wastewater agencies to plan for significant water quality impacts to rivers downstream from urban areas.

The plan further describes the vulnerabilities facing our water delivery systems. These include numerous potential points of system failure, at reservoirs, intakes, treatment plants, pump stations, and outfalls. Many materials are inflexible, joints are push-on, and pipelines may be prone to failure at connections to above-ground structures. Vulnerabilities also include interdependence with other potentially damaged systems, such as power, transportation, chemical, and financial industries. Water from leaks and breaks in water pipelines and private plumbing systems will cause collateral damage, drain available water storage, and contribute to loss of water supply and pressure, which will in turn result in a loss of fire protection capability.

Finally, the performance of gravity sanitation and storm sewers depends on accurate grades and slopes, which are disrupted by ground displacement resulting from liquefaction. Because nearly all water and wastewater treatment plants are built near rivers, they are vulnerable to liquefaction and effective mitigation may require rebuilding these plants on more stable soils.

Recommendations from the Oregon Seismic Safety Policy Advisory Commission should be implemented using a phased approach to restoration of water and wastewater services after a Cascadia earthquake and tsunami, beginning with a backbone water and wastewater system for each community, capable of supplying critical community needs.

### Seismic Retrofits

Throughout Oregon, businesses and service providers are taking another look at critical infrastructure and undergoing seismic retrofits where feasible. From roads, to schools, to hospitals, these retrofits receive sizable sums of money from the Oregon Legislature. Water infrastructure—in the agricultural, municipal, industrial, and domestic sectors—also requires seismic upgrades, but these are very expensive. Although some dams, transmission lines, and treatment plants have received state or federal funding for seismic study and upgrade, this type of funding award is uncommon.

**Recommended Action 5.5C**
**Plan and Prepare for Cascadia Subduction Earthquake Event**

Examples of how to implement this action:

- Follow the recommendations provided by the Oregon Seismic Safety Policy Advisory Commission in its *2013 Oregon Resilience Plan*
- Evaluate and retrofit dams and other water infrastructure to meet new seismic standards
- See recommended actions in the infrastructure sections of the IWRS (7.A – 7.C)

## Critical Issue – Water and Land Use

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. Policies 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 zoning and permitting 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 tools 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 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.

## Plan for Changes in Land Use

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 positioned Oregon as a nationally recognized leader in the arena of land conservation and development.[48] Changes in land use, whether to forestlands, wetlands, or other landscapes have an impact on water resources.

**Figure 3-10: Land-Use Planning Goals**

| | | |
|---|---|---|
| Process Goals | Goal 1 | Citizen Involvement |
| | Goal 2 | Land Use Planning |
| Conservation Goals | Goal 3 | Agricultural Lands |
| | Goal 4 | Forest Lands |
| | Goal 5 | Natural Resources, Scenic and Historic Areas, and Open Spaces |
| | Goal 6 | Air, Water & Land Resources Quality |
| | Goal 7 | Areas Subject to Natural Hazards |
| | Goal 8 | Recreational Needs |
| Development Goals | 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 |

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, as shown in Figure 3-10. The Land Conservation and Development Commission will acknowledge a local government's comprehensive plan when it complies with the goals. However, most acknowledged plans have not been updated with current natural resource inventory data since the 1990s.

Many of these planning goals relate to protecting and maintaining water resources, both quality and quantity. These goals provide a common sense foundation for planning and were hard fought to put into place; however, they remain only goals, often without the implementing rules or administration to back them up.

### Goal 3| Agricultural Lands

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.

Goal 3 requires the preservation of agricultural lands for farm use, consistent with the need for agricultural products, open space, and the state's agricultural land-use policy. Counties may authorize farm uses and nonfarm uses that do not have significant adverse impacts on farms or forest practices.

Agricultural land includes lands with productive soils. Classifying soils using objective metrics has been an important component of Goal 3. Soil fertility is taking into account, as well as suitability for grazing, climatic conditions, existing and future availability of water for farm irrigation purposes, existing land-use patterns, technological and energy inputs, and accepted farming practices. Planning guidelines call for buffers between urban growth and agricultural lands, as well as consideration of the "carrying capacity" of the air, land, and water resources of the planning area.

## Goal 4 | Forest Lands

Oregon's forests encompass a large part of many watersheds, particularly in the upper reaches. Forested lands 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.

Limiting land uses that could have a detrimental effect on water quality is one of the purposes of restrictive forest zoning. Development on forestlands is limited by Goal 4 and by county regulations.

## Goal 5 | Natural Resources, Scenic and Historic Areas, and Open Spaces

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 | Air, Water and Land Resources Quality

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.

Urbanization and significant new rural development on what was formerly farm or forestland may alter the stormwater regime and contribute 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 is increasingly a challenge for municipalities and for rural landowners in some areas of the state.

## Goal 7 | Areas Subject to Natural Hazards

Goal 7 directs local governments to adopt plans to keep structures above or out of floodplains and to reduce the risk to people and property from natural hazards, such as floods, landslides, earthquakes, and related hazards such as tsunamis, coastal erosion, and wildfires. This goal requires jurisdictions to apply appropriate safeguards, such as hazard overlay area zones and review standards when planning for and authorizing new development.

In addition, participation in the National Flood Insurance Program addresses the requirements of statewide planning Goal 7 with respect to flood hazards. In Oregon, 260 cities and counties and three Indian tribes participate in the program.

For several years, the National Oceanic and Atmospheric Administration Fisheries Service (NOAA-Fisheries) and the Federal Emergency Management Agency have been working together to identify measures that will reduce negative impacts from the National Flood Insurance Program on salmon, steelhead and other species listed as threatened under the Endangered Species Act (ESA). The National Marine Fisheries Services issued a Biological Opinion in April 2016, concluding that development in floodplains displaces important habitat, which fish utilize during floods, and degrades instream water quality and hydrologic conditions. The Biological Opinion includes recommendations to the Federal Emergency Management Agency for how implementation of the program could be modified to reduce its impact on ESA listed species. The Department of Land Conservation and Development has the lead state role in floodplain management, with mapping and potential impact support from the Department of Geology and Mineral Industries.

### Goal 11 | Public Facilities and Services

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.

## Plan for Population Growth in Oregon

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. Its population has tripled since 1980, now supporting more than 181,000 people, according to the U.S. Census Bureau.[49] 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 urban growth boundary to accommodate growth. Bend, for example, added 2,380 acres to its urban growth boundary in 2016 for long-term growth, and Grants Pass added 822 acres in 2014. 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.

## Integrate Water-Related Information into Land Use Planning

### Information Inputs

Considering the need to comply with several, very different land use goals, the information required 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 distribution maps, 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 maps showing municipal drinking water source area and source water assessment reports (when available) to voluntarily initiate a process to protect drinking water sources. Updated source water assessments are being completed by the Department of Environmental Quality and Oregon Health Authority and will provide improved information about the natural- and human-caused influencing conditions within source areas.

Population and employment forecasts are of interest to municipalities when estimating water demands for residential, industrial and other uses. Individual studies conducted to evaluate land use requests, particularly to show that there is an adequate supply of groundwater 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.

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.

### Underground Injection Control Systems (UICs)

Underground Injection Control systems are any manufactured design, structure, or activity that injects flow into the subsurface of the ground. The UIC program is managed by the Oregon Department of Environmental Quality, with the intent to manage stormwater, remediation of cleanup sites, industrial process waste, large onsite domestic waste, 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.

State regulations require that drinking water wells be at least 500 feet away from UICs to minimize the potential for cross contamination, but it has been difficult to ensure compliance with this requirement because information about existing UICs has been 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.

The greatest challenge to providing the public with the UIC coordinates has been that many UIC locations were submitted inaccurately with the applications. Since 2015, the Department of Environmental Quality has been going through all of its UIC files, comparing addresses to aerial photos and plotting the correct latitudes and longitudes. When this work is completed, UIC locations will be available to the public on a web-based map application. A user will be able to enter an address or a latitude and longitude and immediately see if there are UICs nearby. DEQ plans to complete this project in 2017.

### Data Gaps

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 quality and 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 those rural areas already designated as groundwater administrative 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. Benton County sanitarians have been good partners with the state, recording locations of water wells when they find them, providing maps, and outfitting wells with well identification labels.

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.

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

Examples of how to implement this action:

- Protect natural water bodies in the course of land use decisions, such as wetlands, estuaries, groundwater aquifers, rivers, and lakes
- Locate and document Underground Injection Control Systems
- Develop and share information regarding the location, quantity, and quality of water resources that can be used by local governments in land use decisions
- Improve coordination, technical guidance, and assistance to local governments for land-use decisions with regard to water
- Take next steps to implement land use goals related to water resources—establishing implementing rules, updating acknowledged plans, completing local government plans, applying appropriate safeguards during permitting
- Build partnerships with state and local governments to provide land-use information, such as tax lot information

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 water resources. Such information would help inform updates to local comprehensive plans, shovel-ready certified sites, capital improvement plans, floodplain management, and other activities that contribute to land use decisions.

Improved integration also involves sharing land use data to inform water-related decisions. For instance, counties have varied approaches for sharing tax lot information. Some counties provide this online, some charge a fee, and some do not provide this information at all.

Finding and documenting the location of water wells and improved information regarding underground injection control systems would aid community-based protection and management strategies. This information is critical to protecting drinking water sources during the course of land use decisions.

## Coordinate Between Public Agencies

Each local government responsible for land use management coordinates with various state agencies to ensure that state agency actions, such as permitting, comply with statewide planning goals and local comprehensive plans. 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.

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 the Oregon Department of Aviation and Oregon Department of State Lands have written a new State Agency Coordination Program.

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

**Recommended Action 6.B**
**Improve State Agency Coordination**

Examples of how to implement this action:

- Update State Agency Coordination Programs in partnership with the Department of Land Conservation and Development
- Design each agency permit “contingent” upon approval of all other state agency permits

## Advance Low Impact Development and Green Infrastructure

Runoff from urbanized lands and impervious surfaces such as paved streets, parking lots, and building rooftops during rainfall and snow events often contain 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. Environmental Protection Agency describes urban runoff as one of the leading sources of water quality impairment in surface waters. Urban runoff can also contaminate groundwater. Humans and their actions are the most significant sources of polluted runoff.

The U.S. Environmental Protection Agency describes low impact development and green infrastructure as generally referring to systems and practices that use or mimic natural processes to infiltrate, evapotranspire, or reuse stormwater or runoff on the site where it is generated. A common technique is the use of plants and soils to capture, slow, and filter stormwater and runoff. 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 from an impervious surface such as a roof or parking lot, a use exempt from water right permitting requirements in Oregon, is another useful approach, one that utilizes water as an on-site resource for activities like lawn watering or gardening.

### Technical Resources to Advance Low Impact Development Approaches

The Oregon Environmental Council, a non-profit organization, has partnered with the Department of Environmental Quality and others to develop a publication called *Low Impact Development in Western Oregon: a Practical Guide for Watershed Health*.[50] Published in 2016, this online manual includes both structural and non-structural design and construction ideas. For instance, it describes the use of porous pavement, rain gardens, and tree planting to mimic the flow of water in the natural landscape. It also includes a flexible template so that local jurisdictions can adapt the manual for their own climate, geology, and local setting.

The 2012 Integrated Water Resources Strategy noted that local planning departments need more technical resources and assistance in order to become familiar with low impact development techniques. The above publication helps respond to that recommendation. Additional information and resources should be compiled and maintained online, providing easy access for developers and planners.

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.

**Recommended Action 6.C**
**Encourage Low Impact Development Practices and Green Infrastructure**

Examples of how to implement this action:

- Compile and provide online information on low impact development best practices
- Update local development codes, improving local capacity to review and permit low impact development and green infrastructure designs
- Encourage communities to consider natural infrastructure in lieu of, or as a complement to, built infrastructure

**Highlight Box**

**Green Infrastructure Projects Designed to Improve Water Quality**

Green infrastructure can provide significant water quality benefits. Cities in Oregon, such as Roseburg and Forest Grove, are two such examples:

The Roseburg Urban Sanitary Authority operates a natural treatment system as part of its Roseburg Regional Water Reclamation Facility. Designed to improve water quality in the South Umpqua River, the system uses treatment wetlands, irrigation, overland flow, soil treatment, and historic natural wetlands to reduce concentrations of nitrogen and phosphorous, and to remove chlorine and heat from its wastewater. The site occupies 340 acres of farmland and the total project cost almost $10 million to implement. Funding came from user fees and a loan of $2.4 million from the Infrastructure Finance Authority. The project was presented with the 2015 Water Quality Improvement Award by the Water Environment Federation. The award is presented annually to a program that best demonstrates significant, lasting and measurable excellence in water quality improvement or in the prevention of water quality degradation in a region, basin or water body.

Similarly, the Fernhill Wetlands in Forest Grove comprises about 700 acres owned by Clean Water Services and managed in partnership with the City of Forest Grove and Fernhill Wetlands Council. The Fernhill project is creating natural treatment systems or wetlands to improve water quality by removing nutrients, cooling, and naturalizing water after conventional treatment. Ninety acres of old sewage lagoons were transformed into treatment wetlands with more than 200,000 cubic yards of soil, 15 control structures, 2,400 feet of piping, 750,000 native wetland plants, and 3.5 billion seeds. Birds and wildlife have taken to the 180 logs and snags that were anchored into place, and human visitors are flocking to enjoy the trail improvements, new outdoor classroom areas, and to watch the emerging treatment wetlands.

# Critical Issue – Water-Related Infrastructure

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 fields every day.

Irrigation-related infrastructure is a complex water delivery 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 or drainage infrastructure include:

- Storage facilities, e.g., dams and reservoirs
- Regulating reservoirs
- Wells
- Canals and pipelines
- Pumps and pumping stations
- Headgates, headworks, and valves
- Spillways, siphons, drains, penstocks, and transmission lines
- Telemetry systems
- Measurement devices
- Fish screens and fish passage facilities
- Drainage pumps, ditches, and tiles
- Levees

Agricultural producers continue to evaluate opportunities to expand operations—and irrigation in particular—to lands where soils are most amenable to water and where markets and related services are most accessible.

In the United States, drinking water is also delivered through a complex network of more than one million miles of pipes; 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.

## Use an Asset Management Approach

The approach in the utility industry is to encourage an "asset management" approach, upgrading and replacing water and wastewater infrastructure on a rolling schedule when it no longer serves its purpose. Some pieces of infrastructure no longer serve the purpose for which they were constructed. When wells or dams have significantly deteriorated, for example, the costs of repair may exceed the expected benefits, and proper decommissioning may be a less expensive alternative.

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.

The American Society of Civil Engineers (ASCE) continues to advocate for the use of an asset management approach to maintain and upgrade the nation's infrastructure. In March 2017, ASCE released its national infrastructure report card, giving the nation's infrastructure a D+, in part because of the failure to plan and fund infrastructure upgrades.[51] In Oregon, these needed investments represent tens of billions of dollars.

The ASCE promotes the use of the asset management approach because it provides decision makers with critical information about their capital infrastructure assets and the timing of their future investments. ASCE lays out four key steps for asset management, including: making an inventory of critical assets; evaluating their condition and performance; developing plans to maintain, repair and replace assets; and funding these activities.

## Support 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 agency oversight and inspection is critical to ensure wells are constructed using proper methods, materials, and equipment. Licensed and bonded water well constructors should have the equipment, knowledge, and experience required for proper well construction.

There are a number of actions that the Water Resources Department could take in order to provide more timely well inspections during construction and a more thorough review of well logs to ensure that standards are met. These include requiring a longer lead time between when a well driller files a "start card," signifying intent to construct, and when construction actually takes place. Currently, a driller may submit the start card the same day work begins. By the time the Department processes the notification, the well is often complete and the drill rig has departed the work site.

Other improvements include education and outreach to well drillers and pump installers. Doing so would help ensure that the state has accurate maps and location information about new wells; that industry professionals understand the backflow prevention requirements; and that well owners, their consultants, and agency staff have unobstructed access to measure water levels.

Along with construction requirements, any alteration, deepening, conversion or abandonment of a well must be done in accordance with groundwater laws and well construction standards. Unused wells, particularly large-diameter, open wells that are not properly decommissioned, provide avenues for contamination and are a public safety concern.

In the past ten years, Oregon has seen a number of preventable incidents due to poorly maintained and neglected wells. The incidents included animals falling into wells and needing to be rescued, children being critically injured, and an elderly woman in Douglas County dying after falling into a large-diameter well. Homeowners with old unused, neglected, or poorly maintained wells should contact the Water Resources Department for information regarding the proper methods of decommissioning their wells.

## Improve Oregon's Levees

Levees are used around the country to protect low lying areas from river flooding, coastal flooding, and other floods that are aggravated by high tides. Levees are very similar to embankment dams, in that they are generally constructed of local soils and intended to retain water without leakage or overtopping. Levees can impact riparian and floodplain functions and only provide flood protection if they are of sufficient height and stability. Even then, levees must be monitored during flooding, with leakage and overtopping identified correctly and immediately addressed. Failure of levees in some cases can be catastrophic, as was the case with Hurricane Katrina and the 2005 levee breaches in New Orleans.

Oregon has also experienced a catastrophic levee breach when a levee adjacent to the Columbia River failed, killing 15 people and destroying the City of Vanport in 1948. At the time, it was the second largest city in Oregon and the largest public housing project in the nation. The 2017 Oregon Legislature adopted Senate Concurrent Resolution 21 to commemorate the anniversary of the Vanport flood, remembering its survivors and those who lost their lives.[52]

The U.S. Army Corps of Engineers sponsors and certifies a portion of the levees in Oregon. The Corps keeps an inventory of those levees it sponsors and certifies. In exchange for assistance with inspections and emergency response, owners of those levees are required to maintain them to federal standards. These levees are well inventoried, frequently inspected and have a reasonable margin of safety. The Corps is not routinely involved in levees constructed to manage coastal (tide related) flooding.

There are other levees in Oregon that have not been maintained to federal standards, nor are they part of the Corps of Engineers certification program. Some of these other levees have been inventoried, while many have not. These levees may be in very poor condition and may need to be removed or rehabilitated. The ownership of these levees is often unclear. In some cases, landowners may be unaware that levees exist on their property or could be affected by a levee failure.

The Department of Geology and Mineral Industries is inventorying levees as resources become available. The 2015 Legislature granted the Water Resources Department the authority to work with willing owners to evaluate repair, removal, or other options for these other levees. The 2017 Legislature authorized $10 million for Business Oregon to provide financial assistance for levee projects that result in improvement, expansion, or repair and are essential for the use or development of farm, industrial, or commercial land in Oregon.

**New Standards for Levee Certification –** Levees must be accredited to be recognized in the Federal Emergency Management Agency's flood insurance program. An accredited designation means that a levee is built and maintained to protect against a one-percent-annual-chance flood event, commonly known as the 100-year flood. To achieve accreditation, a professional engineer must certify the levee. Levee failures resulting from Hurricane Katrina spurred the U.S. Army Corps of Engineers to re-evaluate their levee inspection and certification program. New evaluation standards were established in 2012 for all levee certifications, including those that were previously completed.

Several drainage districts that own and operate levees along the Columbia and Willamette Rivers near Sauvie Island are actively working on levee accreditation. In return, the districts will have access to federal floodplain insurance at a lower cost than without accreditation.

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

Examples of how to implement this action:

- Use an "asset management" approach to identify and plan for rehabilitation, upgrade, or replacement of infrastructure
- Provide timely inspection of well construction, review of well logs, and educate drillers and pump installers to ensure construction standards are met
- Inventory, inspect, and make safety improvements to levees
- Properly decommission infrastructure, such as a well, culvert, levee, or dam, at the end of its useful life

## Encourage Regional Systems

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.

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

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

Examples of how to implement this action:

- Make use of shared contracts, services, purchases
- Develop mutual assistance agreements
- Establish inter-ties and back-up supplies
- Provide incentives to encourage regional approaches

contracts, services, purchases, mutual assistance agreements, interties, and back-up supplies. State and federal agencies often provide incentives such as funding and technical assistance to encourage a regional approach to meeting water needs. Four communities are currently piloting a place-based approach to water planning that looks at water supply and demand within a basin or other hydrologic area. Some of the outcomes of those planning efforts may incorporate a more "regional" approach. For more information, refer to Chapter 4.

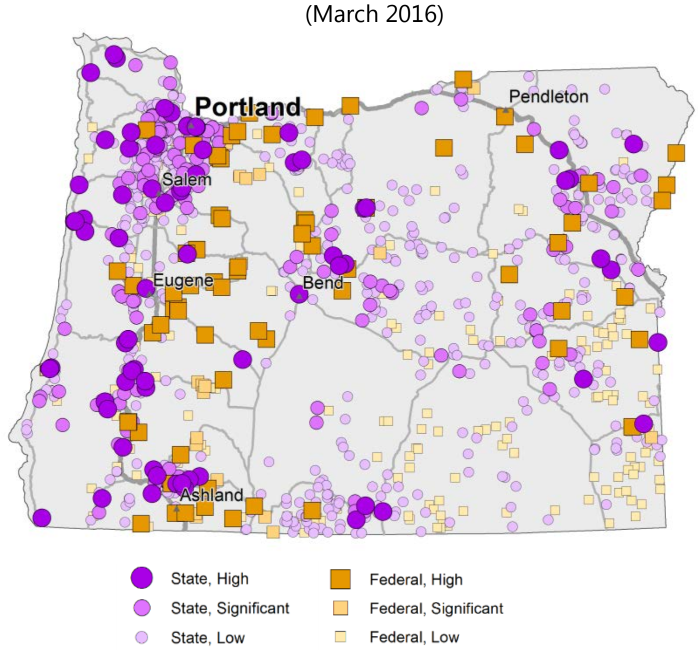
Oregon should continue providing these types of incentives, encouraging regional approaches to water and wastewater services, particularly if these approaches create efficiencies for smaller communities. Organizations such as the Oregon Association of Clean Water Agencies (ORACWA) can play a key role in making connections and encouraging regional approaches among water and wastewater systems.

## Ensure Public Safety: Oregon's Dam Safety Program

Although the concept of drinking water safety to protect human health has always been included in the Integrated Water Resources Strategy, the concept of public safety has not. In this 2017 Strategy, we bring renewed attention to dam safety, which represents a significant area in which the state has responsibility for the communities located downstream from important but aging water impoundments.

Dams are not defined in statute, but rather in rule (Oregon Administrative Rule 690-020-0022(8)). "Dam" means a hydraulic structure built above the natural ground grade line that is used to impound water. Dams include all related structures, and together are sometimes referred to as "the works." Dams can include wastewater lagoons and other hydraulic structures that store water, attenuate floods, and divert water into canals. Many traditional dams are constructed on stream channels to form reservoirs. Most dams are built of compacted soil or rock fill and are called embankment dams; a few are made of lumber. Concrete dams, although less common, are some of Oregon's largest dams. Owners of dams include homeowners, farmers, irrigation districts, private industry, municipalities, associations, and public agencies.

**Figure 3-11: Federal and State Regulated Dams**
(March 2016)




### Managing Oregon's Dam Safety Program

Oregon strives to maintain a good dam safety record to ensure public safety. The Association of State Dam Safety Officials notes that while "dams bring water, power, flood control, recreation, economic possibilities and many other advantages to people...people must understand that safe operation and maintenance is key to sustaining these advantages and avoiding potential disaster."

Oregon Revised Statutes (ORS) authorize and direct the Water Resources Department to take specific actions related to the design, construction, inspection, and safety of dams. The applicable statutes that deal directly with dam safety are ORS 540.340 to 540.400. Oregon's dam safety laws, established in 1929, are outdated, making effective actions to improve public safety very difficult. Since the last time these statutes were changed, there have been major advances in dam design, rehabilitation technology, and emergency planning standards to protect people living downstream from dams.

The State Engineer for Water Resources oversees the dam safety program and inspects all of the state-regulated high hazard dams, with one engineer to help. Among its western neighbors, Oregon has invested the lowest program dollars per dam ($365), compared to the national average of $610 per dam. Similarly, Oregon dedicates less staff per dam for inspections. Note, however, that among their many duties, Oregon's twenty-one watermasters do conduct inspections of low- and significant-hazard dams.

**Those Subject to the Dam Safety Program –** Approximately 1,200 dams in Oregon are at least 10 feet high and store 3 million gallons or more (9.2 acre-feet of water), making them subject to Oregon's dam safety program. The largest dams, however, are regulated by federal agencies. The Water Resources Department is the lead public authority responsible for 969 non-federal dams. See Figure 3-11 for a map of all large dams in Oregon.

**Hazard Ratings –** Like most states, Oregon rates dams by hazard classification—high, medium, or low. A dam's hazard rating is based on what could happen if the dam fails, not on the condition of a dam. A high hazard dam, for example, means that failure would likely cause fatalities. There are currently 75 non-federal dams rated as high hazard. These dams are inspected annually.

**Figure 3-12: Hazard Classifications for Dams**

**75** **High Hazard Dams**
Failure will likely cause fatalities. These dams are inspected annually.

**147** **Significant Hazard Dams**
Failure will damage properties but loss of life is unlikely. These dams are inspected every 2 to 3 years.

**747** **Low Hazard Dams**
Failure is unlikely to cause major property damage or loss of life. These dams are inspected every 5 to 6 years.

**969** **Total Dams in the Program**

Source: OWRD, November 2017

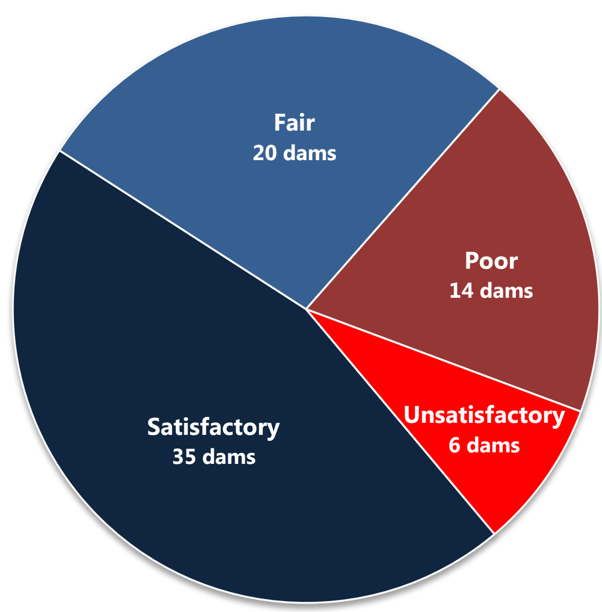
## Safety of Dams

The original focus of Oregon's dam safety program was the review and approval of designs for new dams. A majority of Oregon's dams were constructed decades ago, with some more than 100 years old. As a result, the dam safety program now focuses on evaluating the condition of existing dams through regular inspections and providing feedback to owners regarding needed safety improvements.

High hazard dams are evaluated using four categories: satisfactory, fair, poor, and unsatisfactory. Refer to Figure 3-13 for the condition of Oregon's high hazard dams.

The condition analysis of each high hazard dam is updated after its formal inspection. There are no clear criteria in Oregon for determining when an unsatisfactory dam is also an unsafe dam. Some states consider all dams in unsatisfactory condition as unsafe unless there is a significant restriction in the volume of water storage allowed at that dam. Other states also consider dams in poor condition to be unsafe.

**Figure 3-13: High Hazard Dams by Condition**



The Department works with owners to bring these dams up to current seismic safety standards. Many of Oregon's dams are old and could fail, greatly increasing the severity and consequences during major flooding. A number of pipes passing through dams have worn out as well. Additional resources are needed to determine if dams have safety or seismic deficiencies.

**Emergency Authorities –** In Oregon, if it is clear that a dam is imminently unsafe, the Department will notify the owner and schedule a hearing to see if a water level restriction or other action is deemed warranted by an administrative law judge in accordance with the dam safety statutes and Oregon administrative law. The process takes several months unless the owner voluntarily signs a consent agreement. At present, the Water Resources Department has no authority to direct an owner to take action to prevent imminent dam failure, nor can the Department take action if owners are unavailable or unwilling. If caught in time, lowering reservoir levels can reduce stress on the dam and reduce its likelihood of catastrophic failure. Other actions include bringing in pumps or siphons, using emergency rock fill, opening valves, or removing unsafe dams.

**Emergency Inspection after Extreme Events –** Oregon has no interagency agreements in place to inspect multiple dams damaged by an earthquake or widespread flood. After extreme floods and multiple dam failures in 2013 and 2015, Colorado and South Carolina had to improvise, but fortunately, both states had federal and local dam safety engineers available to make inspections quickly. In Oregon, this will be difficult after a Cascadia Earthquake or flood if access via roads is no longer possible. Dam inspections and emergency access is essential to avoid dam failures in the aftermath of a Cascadia Earthquake or significant flood. Additional arrangements are needed for effective and coordinated response during extreme events so that the public can be reassured that dams are safe, or evacuated, if necessary.

**Legal Responsibilities for Dam Safety –** The Association of State Dam Safety Officials notes that dams are a unique type of infrastructure, because while public entities tend to own roads, bridges, and sewer systems, this is not the case with dams. The majority of dams in the United States are privately owned. The Association notes that, "a dam's owner is solely responsible for the safety and liability of the dam and for financing its upkeep, upgrade, and repair." While the term "legal responsibility" of a dam owner is used in statute (ORS 540.350), it is not defined. Owners should know what their responsibilities are, including keeping the dam safe and taking immediate action if the dam begins to fail and threaten people or property.

**Monitoring High Hazard Dams –** Remote monitoring can detect a potential problem before there is harm to people and property. The most important information includes the current water level in the reservoir and any change in seepage flow through the dam. A few dam owners are already collecting and analyzing this information now, as it allows them to improve the performance and safety of their dams. Other owners do not monitor their dams. The Water Resources Department is not authorized to require monitoring on high hazard dams, even those in poor or unsatisfactory condition.

**Emergency Action Plans –** An Emergency Action Plan (EAP) helps identify situations where a dam failure might occur, and spells out actions that could save the dam and hasten evacuations. Approximately 75 percent of state-regulated high hazard dams have EAPs. The 2017 Legislature passed a bill requiring owners or operators of high-hazard dams to develop an emergency action plan and file it with the Water Resources Department, Office of Emergency Management, and the local county emergency agency no later than January 1, 2019.

**Review of Preliminary Plans and Specifications –** The first step to developing a safe dam and sound reservoir is a site feasibility evaluation. This evaluation is then used for the next step of developing preliminary plans and specifications for a dam. In other states, early review of preliminary plans and specifications is a typical responsibility of state government. Currently, however, Oregon has neither resources nor standards for an early review of preliminary plans and specifications. In the past, some dams have been designed and sometimes built without addressing these critical first steps, only to require expensive rehabilitation or removal at a later date.

Feasibility evaluations should clarify the owners' objectives; evaluate water supply and flows, identify poor rock or soils, landslides and faults; and evaluate potential fish, aquatic and water quality issues. If the dam is feasible, the best site and height are determined. Preliminary plans and specifications include a summary report with drawings showing the dam location, height, and anticipated location of a spillway conduit, and where needed, provisions for fish and water quality. These plans are an early version of the design and help focus on what is needed to construct a safe, functional, and protective reservoir.

Improved ability for the Department to conduct more timely reviews and to correspond with engineers from preliminary to final design would result in more certainty and consistency for dam owners and project engineers.

**Grant and Loan Programs –** Most conventional loan programs cannot be applied to dam repair or maintenance, and since many dams are privately owned, many owners do not have the financial resources necessary to rehabilitate their dams. This is especially true for dams that generate no income. It is essential to inspect, monitor and analyze those dams with known deficiencies. With older dams, there are often a great number of unknowns, uncertainties, and defects, including the reliability or existence of design information.

Recently, the dam safety program and other grant programs provided some funds to dam owners to conduct structural analysis of high hazard dams.

Although Oregon has efficiently leveraged limited resources to improve the overall safety of state-regulated dams, many important activities have been deferred, some indefinitely. Establishing formal grant and loan programs would allow owners to make seismic upgrades, rehabilitate unsafe dams that still have value, or to provide funds for removal of dams that no longer provide benefits.

Congress signed the Water Infrastructure Improvements for the Nation (WIIN) Act into law in 2016, authorizing a national dam rehabilitation and repair program.[53] The goal is to help dam owners implement needed repairs and upgrades. However, this program has not yet been funded. Similarly, the federal National Dam Safety Program was reauthorized by Congress as part of the Water Resources Reform and Development Act (WRRDA) in 2014; this program also has not received its full appropriation at authorized levels.[54]

**Recommended Action 7.C**
**Ensure Public Safety / Dam Safety**

Examples of how to implement this action:

- Modernize state laws to improve the safety and resiliency of Oregon dams
- Authorize resources to determine if dams have safety deficiencies; evaluate and retrofit dams to meet new seismic standards
- Authorize emergency actions and encourage cooperative actions to improve the safety of dams
- Properly decommission dams at the end of their useful life.
- Coordinate interagency emergency responses regarding dam inspection, communication, and evacuation
- Define the legal responsibilities of a dam owner
- Authorize a requirement for remote monitoring on deficient high hazard dams
- Dam owners should prepare and implement an Emergency Action Plan for all existing dams rated high hazard
- Authorize a fee for review of plans and specifications
- Dedicate grant and loan resources for rehabilitation of deficient dams

# Critical Issue – Education and Outreach

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. Often, 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.

## Support Oregon's K-12 Environmental Literacy Plan

### Environmental Literacy

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.

Finalized in October 2010, the Environmental Literacy Plan 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. 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 natural resources in the future. Under this Plan, students graduating from high school should be environmentally literate.

In 2014, Oregon State University became the administrative body overseeing the state's Environmental Literacy Program to help implement the plan. The program supports K-12 teachers by providing professional development training, conducting research and assessment, maintaining a database of resources, and building capacity through partnerships.

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

Examples of how to implement this action:

- Support implementation of the Environmental Literacy Plan
- Natural resource agencies, community organizations, and others should engage in education for environmental literacy activities

Fortunately, high quality, water-related curricula already exists for K-12 educators. 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.

### Outdoor School

Oregon State University will also serve in a leadership role for Oregon's "Outdoor School" program, a week-long field science curriculum for fifth and sixth graders, focusing on the environment, natural resources, economic development, and related careers. Since the late 1950s, nearly one million students have participated, studying natural sciences and the responsible use of natural resources with students from other schools. Participation in Outdoor School varies by school district and has not been available on a statewide basis. Ballot Measure 99 was passed in 2016 by voters, creating an Outdoor School Education Fund with four percent of funding coming from Oregon State Lottery money—up to $22 million—with the stipulation that these efforts cannot reduce lottery proceeds dedicated to the restoration and preservation of parks, beaches, watersheds, and native fish and wildlife.[55]

**Figure 3-14: Children's Clean Water Festival**

Staff from the Water Resources Department gave a groundwater demonstration to students at the Children's 2016 Clean Water Festival.

### Children's Clean Water Festival

The Children's Clean Water Festival, held in the Portland metro area, 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 fourth and fifth grade students 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. The 2017 Clean Water Festival marks the 24th year of the event with more than 30,000 students participating since its inception. Several partnering agencies provide financial and staff time, with more than 125 classroom presenters, exhibitors, and community members volunteering annually at the event.

## Educate 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 Research Foundation and the American Water Works Association published a report in 2010 that summarizes previous studies on the workforce issues facing the water sector. Studies estimate that there could be a loss of 30 to 50 percent of water utility employees in the next 10 years, due to retirement, with the greatest impact on engineering and operations. With this comes a loss of institutional knowledge, as retirees exit the workforce.[56]

Add to this a 2003 Congressional Budget Office study that noted 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 concern 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 May 2010 issue of the journal *Science*, 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.

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 and geologists 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.

Hydrogeologists 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 in Albany and Clackamas Community College in 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.

Nationally, there are numerous professional societies that support the water sector industry by offering special workshops, conferences, continuing education opportunities, and access to the latest research. Several local chapters exist in Oregon and cover a wide range of disciplines, such as groundwater, wastewater, and drinking water, for example.

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

Examples of how to implement this action:

- Determine whether career training programs are available and equipped to meet the coming demand for water professionals
- Offer job shadow programs to expose students to careers in water
- Continue funding support for water-related trade programs at Oregon community colleges

Only one community college, Lane Community College in Eugene, offers 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 processing records for use.

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 Office of Community Colleges and Workforce Development also provides a listing of colleges that offer water-related courses, degrees, and programs throughout Oregon.

## Provide Community-Based Education and Outreach

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 locally-led education and outreach efforts. Oregon should continue providing technical training to soil and water conservation districts, watershed councils, and other on-the-ground organizations.

Federal agencies, such as the U.S. Environmental Protection Agency and the U.S. Geological Survey also have water-related resources available for education. Many local water providers, watershed councils, and non-profit organizations in Oregon have also developed their own educational and outreach materials, making them available to the public.

State agencies will also need to play a role in community-based education and outreach. Oregon needs an accessible, outward facing communications platform for sharing water information and trends. The Water Resources Department is best suited to fulfill this role and could develop an educational series on a variety of topics, such as water rights, funding opportunities, best practices, and new technology. More broadly, agencies can help express the importance of water needs in each sector and the value of collaborative decision-making in resolving conflicts.

Some other examples of education and outreach opportunities that should be promoted by a variety of partners include:

- Farm-to-farm tours to demonstrate water conservation and efficiency techniques
- Improving stewardship by connecting Oregonians to the outdoors
- Domestic well stewardship: proper installation and maintenance of domestic wells, wellhead protection, testing wells for contaminants, interpreting the results, addressing any contaminants
- Proper care/maintenance for septic systems
- Graywater use systems
- Rainwater harvesting systems
- Pharmaceutical take back programs, hazardous waste collection events
- Streamflow restoration programs, such as the allocation of conserved water program and instream transfers or leases

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.

Another example is the Oregon State Marine Board, which offers numerous environmental and recreation-based boating safety programs, often partnering with other agencies such as the Department of Fish and Wildlife and Parks and Recreation Department. Some of these programs include:

- Water Wits, a K-12 curriculum with interactive lessons in boating, water safety and marine stewardship
- Interactive Boat Oregon Map of public boating access facilities and other important data layers. This includes launch ramps, boating obstructions, Certified Clean Marinas, pumpouts and floating restrooms, clear gasoline locations, rivers where personal watercraft (e.g. jets skis) are allowed, boating regulations and boating waterways
- Information on boating obstructions, found at www.boatoregon.com/obstructions. This information is verified and mitigated (where possible) by marine law enforcement
- Nationally accredited boater education courses
- Free online paddling education and promotion of Oregon Water Trails

The Oregon State Marine Board also conducts outreach and education through the Aquatic Invasive Species Prevention Permit, Clean Marina and Clean Boater programs. These recreation-based outreach and education programs should be promoted and encouraged in Oregon.

**Recommended Action 8.C**
**Promote Community Education and Training Opportunities**

Examples of how to implement this action:

- Look for opportunities to keep the general public informed about the importance of water resources
- Look for opportunities to provide outreach about streamflow restoration, water conservation, transfers, and other programs and tools
- Promote technical training for public and private partners
- Promote access to water-related recreational opportunities through the use of state programs

## 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 universities, research institutions, and other partners.

Several state and federal agencies offer internship programs for students to gain real-world experience and exposure to day-to-day operations. Business Oregon, for example, has an internship program that includes work in clean technology and renewable energy. Other agencies – the Department of Fish and Wildlife, Department of Forestry, and Water Resources Department – often provide summer internships or seasonal employment opportunities to support monitoring and assessment projects, or other field-based activities. Local agencies, such as water providers, are key partners in research, helping to bring science into practice.

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

Examples of how to implement this action:

- Continue to identify ongoing research needs at the local and state level
- Partner with public and private institutions to address research needs
- Participate in research initiatives

Students in these internships have a unique opportunity to seek out both theoretical and applied research questions. They can take these questions back to their undergraduate or graduate programs and use them as the basis for their own original research and publication.

## Recommended Actions at a Glance

| Critical Issue | Recommended Action |
|---|---|
| Water and Energy | **4.A** Analyze the Effects on Water from Energy Development Projects and Policies<br>**4.B** Take Advantage of Existing Infrastructure to Develop Non-Traditional Hydroelectric Power<br>**4.C** Promote Strategies That Increase/Integrate Energy and Water Savings |
| Climate Change | **5.A** Support Continued Basin-Scale Climate Change Research Efforts<br>**5.B** Assist with Climate Change Adaptation and Resiliency Strategies |
| Extreme Events | **5.5A** Plan and Prepare for Drought Resiliency<br>**5.5B** Plan and Prepare for Flood Events<br>**5.5C** Plan and Prepare for Cascadia Subduction Earthquake Event |
| Water and Land Use | **6.A** Improve Integration of Water Information into Land Use Planning (& Vice-Versa)<br>**6.B** Improve State Agency Coordination<br>**6.C** Encourage Low Impact Development Practices and Green Infrastructure |
| Water-Related Infrastructure | **7.A** Develop and Upgrade Water and Wastewater Infrastructure<br>**7.B** Encourage Regional (Sub-Basin) Approaches to Water and Wastewater Systems<br>**7.C** Ensure Public Safety / Dam Safety |
| Education and Outreach | **8.A** Support Implementation of Oregon's K-12 Environmental Literacy Plan<br>**8.B** Provide Education and Training for Oregon's Next Generation of Water Experts<br>**8.C** Promote Community Education and Training Opportunities<br>**8.D** Identify Ongoing Water-Related Research Needs |

# References


[1] U.S. Department of Energy. 2014. The Water-Energy Nexus: Challenges and Opportunities. Washington, D.C. https://energy.gov/sites/prod/files/2014/07/f17/Water%20Energy%20Nexus%20Full%20Report%20July%202014.pdf

[2] Northwest Power and Conservation Council. 2016. Seventh Power Plan. https://www.nwcouncil.org/energy/powerplan/7/plan/

[3] Oregon Department of Energy. 2017. Facilities under the Energy Facilities Siting Council. Salem, Oregon. http://www.oregon.gov/energy/facilities-safety/facilities/Pages/Facilities-Under-EFSC.aspx

[4] Northwest Power and Conservation Council. 2014. Columbia River Basin Program.

[5] Oregon Legislature. 2013. Senate Bill 837. https://olis.leg.state.or.us/liz/2013R1/Downloads/MeasureDocument/SB837

[6] Oregon Association of Clean Water Agencies. 2017. ACWA Awards Webpage. http://www.oracwa.org/a-acwa-awards.html

[7] Oregon Department of Consumer and Business Services, Building Codes Division. 2017. Adopted Codes Online. https://www.oregon.gov/bcd/codes-stand/Pages/adopted-codes.aspx

[8] Oregon Department of Consumer and Business Services, building Codes Division. 2017. Statewide Alternate Methods. https://www.oregon.gov/bcd/codes-stand/Pages/alternate-methods.aspx

[9] Oregon Department of Consumer and Business Services, Building Codes Division. 2017. Reach Program. https://www.oregon.gov/bcd/codes-stand/Pages/reach.aspx and http://www.oregon.gov/bcd/Documents/brochures/3660.pdf.

[10] Oregon Department of Agriculture. 2013. Oregon State of the Agriculture Industry Report. http://library.state.or.us/repository/2009/200903310943442/2013.pdf

[11] Intergovernmental Panel on Climate Change. 2014. Climate Change 2014 Synthesis Report for Policy Makers. http://www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_SPM.pdf

[12] Weber, Jeffrey. 2010. Climate Change Adaptation Framework for the State of Oregon. Department of Land Conservation and Development. Salem, Oregon. https://www.oregon.gov/LCD/docs/climatechange/framework_summary.pdf.

[13] Weber, Jeffrey. 2014. Regional Framework for Climate Adaptation—Clatsop and Tillamook Counties. Department of Land Conservation and Development. Salem, Oregon. https://www.oregon.gov/LCD/OCMP/docs/Publications/Regional_Framework_Adapt_Clat_Till.pdf.

[14] Oregon Legislature. 2007. House Bill 3543. Salem, Oregon. https://olis.leg.state.or.us/liz/2007R1/Downloads/MeasureDocument/HB3543/Enrolled.

[15] Oregon Global Warming Commission. 2017. Biennial Report to the Legislature. Salem, Oregon. http://www.keeporegoncool.org/sites/default/files/ogwc-standard documents/OGWC%202017%20Biennial%20Report%20to%20the%20Legislature_final.pdf

[16] National Oceanic Atmospheric Association. 2016. State of the Climate: Global Analysis for November 2016. NOAA National Centers for Environmental Information.

[17] Dalton, M.M., K.D. Dello, L. Hawkins, P.W. Mote, and D.E. Rupp. 2017. The Third Oregon Climate Assessment Report, Oregon Climate Change Research Institute, College of Earth, Ocean and Atmospheric Sciences, Oregon State University, Corvallis, Oregon. http://www.occri.net/publications-and-reports/third-oregon-climate-assessment-report-2017/

[18] Hamlet, A. F., M. M. Elsner, G. S. Mauger, S.-Y. Lee, I. Tohver, and R. A. Norheim. 2013. An Overview of the Columbia Basin Climate Change Scenarios Project: Approach, Methods, and Summary of Key Results.” Atmosphere-Ocean 51 (4): 392-415. doi: 10.1080/07055900.2013.819555.

[19] Elsner, M. M., L. Cuo, N. Voisin, J. S. Deems, A. F. Hamlet, J. A. Vano, K. E. B. Mickelson, S. Lee and D. P. Lettenmaier. 2010. Implications of 21st Century Climate Change for the Hydrology of Washington, State. Climatic Change 102: 225-260. doi: 10.1007/s10584-010-9855-0.

[20] Fischer, G., M. Shah, and H. van Velthuizen. 2002. Impacts of Climate on Agro-Ecology. In Climate Change and Agricultural Vulnerability, 38–91. Vienna, Austria: IIASA.

[21] Westerling AL. 2016. Increasing western U.S. forest wildfire activity: sensitivity to changes in the timing of spring. Phil. Trans. R. Soc. B 371(1696): 20150178. DOI: 10.1098/rstb.2015.0178.

[22] Mantua, N., I.Tohver, and A. Hamlet. 2010. Climate Change Impacts on Streamflow Extremes and Summertime Stream Temperature and Their Possible Consequences for Freshwater Salmon Habitat in Washington State. Climatic Change 102 (1): 187-223. doi: 10.1007/s10584-010-9845-2. (Note: as cited in the 2013 Oregon Climate Assessment Report, “Climate Change in the Northwest.”)

[23] Isaak, D. J., C. C. Muhlfeld, A. S. Todd, R. Al-Chokhachy, J. Roberts, J. L. Kershner, K. D. Fausch, and S. W. Hostetler. 2012. The Past as Prelude to the Future for Understanding 21st-Century Climate Effects on Rocky Mountain Trout. Fisheries 37 (12): 542-556. doi: 10.1080/03632415.2012.742808. (Note: as cited in the 2013 Oregon Climate Assessment Report, "Climate Change in the Northwest.")

[24] Oregon Health Authority. 2017. Oregon Climate and Health Resilience Plan. https://public.health.oregon.gov/HealthyEnvironments/climatechange/Pages/resilience-plan.aspx

[25] Whitely Binder, L.C. and J. Jurjevich. Winds of Change? Exploring Climate Change-Driven Migration and Related Impacts in the Pacific Northwest. (2016). Portland, Oregon: Portland State University Population Research Center (Portland, Oregon) and the University of Washington Climate Impacts Group (Seattle, Washington). http://pdxscholar.library.pdx.edu/cgi/viewcontent.cgi?article=1037&context=prc_pub&utm_content=buffer02628&utm_medium=social&utm_source=twitter.com&utm_campaign=buffer

[26] Oregon Water Resources Department. 2017. Oregon Water Conditions Report for September 5, 2017

[27] Brown, Governor Kate. 2015. Executive Order 15-09: Directing State Agencies to Plan for Resiliency to Drought, to Meet the Challenge that a Changing Climate Brings. Salem, Oregon. https://www.oregon.gov/gov/Documents/executive_orders/eo_15-09.pdf

[28] Oregon Office of Emergency Management and Water Resources Department. 2016. Drought Annex: State of Oregon Emergency Operations Plan. Salem, Oregon. http://www.oregon.gov/owrd/WR/docs/OR%20EOP_2015_IA%2001%20drought(2).pdf

[29] Wisler E. 2016. Drought and Oregon's Outdoor Recreation. The Climate Circulator. https://climatecirculatororg.wordpress.com/2016/06/22/drought-and-oregons-outdoor-recreation/

[30] Stevenson, John. 2016. Documenting the Drought. The Climate Circulator. https://climatecirculatororg.wordpress.com/2016/05/24/documenting-the-drought/

[31] U.S. Department of Agriculture's National Agricultural Statistics Service. July 6, 2015. Oregon Crop Progress and Condition. https://www.nass.usda.gov/Statistics_by_State/Idaho/Publications/Crop_Progress_&_Condition/2015/CW0414.pdf

[32] Stevenson, John. 2016. Documenting the Drought. The Climate Circulator. https://climatecirculatororg.wordpress.com/2016/05/24/documenting-the-drought/

[33] Stevenson, John. Success Stories. Agriculture Climate Network. 2015. https://www.agclimate.net/success-stories/

[34] See USDA, above.

[35] U.S. Department of Agriculture. 2016. Narrative Timeline of the Pacific Northwest Wildfire Season. https://wfmrda.nwcg.gov/docs/_Reference_Materials/2015_Timeline_PNW_Season_FINAL.pdf

[36] Oregon Legislative Fiscal Office. 2016. 2015 Fire Season Costs – Budget Information Brief. http://www.oregon.gov/ODF/Board/Documents/FireProgramReview/LFO%202015%20Fire%20Season%20Costs.pdf

[37] Washington State Department of Agriculture. 2015 Drought and Agriculture. 2017. AGR PUB 104-495 (N/2/17). http://agr.wa.gov/FP/Pubs/docs/495-2015DroughtReport.pdf

[38] Drought Task Force. 2016. Report of the Task Force on Drought Emergency Response. Salem, Oregon. https://www.oregon.gov/owrd/docs/HB4113/Draft_Final_Task_Force_Report_11_1_2016_Final.pdf

[39] IWRS Policy Advisory Group. 2017. Final Report. Salem, Oregon. http://www.oregon.gov/owrd/LAW/docs/IWRS/PAG%20Memo%20to%20the%20%20Water%20Resources%20Commission_Final.pdf

[40] National Institute of Building Sciences' Multi-Hazard Mitigation Council. 2005. Natural Mitigation Saves: an Independent Study to Assess the Future Savings from Mitigation Activities. Washington, D.C. https://c.ymcdn.com/sites/www.nibs.org/resource/resmgr/MMC/hms_vol1.pdf.

[41] Oregon Department of Land Conservation and Development. 2015. Oregon Natural Hazards Mitigation Plan. https://www.oregon.gov/LCD/HAZ/docs/2015ORNHMP/2015ORNHMPApproved/Approved_2015ORNHMP.pdf

[42] Colorado Department of Natural Resources. 2013. *Drought Mitigation and Response Plan. Denver, Colorado.* http://cwcb.state.co.us/water-management/drought/documents/statedroughtmitplan2013/coloradodroughtmitigationresponseplan2013.pdf

[43] Taylor, George and Raymond R. Hatton. 1999. The Oregon Weather Book: A State of Extremes. Corvallis: Oregon State University.

[44] National Oceanic and Atmospheric Association. 2015. *What Are Atmospheric Rivers?* http://www.noaa.gov/stories/what-are-atmospheric-rivers

[45] Rupp, David E., and Sihan Li. 2016. Less warming projected during heavy winter precipitation in the Cascades and Sierra Nevada. International Journal of Climatology.

[46] National Oceanic and Atmospheric Administration's Earth System Research Laboratory. 2017. Notable Atmospheric River Events. https://www.esrl.noaa.gov/psd/atmrivers/events/

[47] Oregon Seismic Safety Policy Advisory Commission. 2013. The Oregon Resilience Plan Executive Summary. https://www.oregon.gov/OMD/OEM/osspac/docs/Oregon_Resilience_Plan_Executive_Summary_Final.pdf

[48] Oregon Legislature. 1973. Senate Bill 100. https://www.oregon.gov/LCD/docs/bills/sb100.pdf.

[49] United States Census Bureau. 2016. Quick Facts for Deschutes County. Accessed March 23, 2017. https://www.census.gov/quickfacts/table/PST045215/41017

[50] Oregon Environmental Council et al. 2016. Low Impact Development in Western Oregon: a Practical Guide for Watershed Health. http://www.oregon.gov/deq/wq/tmdls/Pages/TMDLs-LID.aspx.

[51] American Society of Civil Engineers. 2017. Infrastructure Report Card. http://www.infrastructurereportcard.org/

[52] Oregon Legislature. 2017. Senate Concurrent Resolution 21. https://olis.leg.state.or.us/liz/2017R1/Downloads/MeasureDocument/SCR21/Introduced.

[53] U.S. Congress. 2016. Water Infrastructure Improvements for the Nation (WIIN) Act. https://www.congress.gov/bill/114th-congress/senate-bill/612/text

[54] U.S. Congress. 2014. Water Resources Reform and Development Act (WRRDA). https://www.govtrack.us/congress/bills/113/hr3080/text

[55] People of the State of Oregon. 2016. Measure 99: Outdoor School Lottery Fund *Initiative*. https://ballotpedia.org/Oregon_Outdoor_School_Lottery_Fund,_Measure_99_(2016)

[56] Water Research Foundation and American Water Works Association. 2010. Water Sector Workforce Initiative. http://www.waterrf.org/publicreportlibrary/4206.pdf

# CHAPTER 4

## Meet Instream and Out-of-Stream Needs

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 require adequate funding.

**Quick Links to Main Sections:**

# Critical Issue – Place-Based Efforts

The 2012 Strategy specifically called for the state to create a statewide framework for developing place-based integrated water resources plans. The Water Resources Department researched how other states encourage and support integrated water planning at the local level and also gathered feedback through a series of public workshops, interagency meetings, and other venues. This research and feedback were used to develop a set of draft planning guidelines that outline how communities can undertake place-based planning.

The 2015 Draft Planning Guidelines (Guidelines) present a framework for Oregonians to plan for their water future.[1] The Guidelines include key planning principles as well as five planning steps:

- **Step 1** – Build a collaborative and inclusive process with diverse water interests
- **Step 2** – Gather information to characterize water resources and identify knowledge gaps
- **Step 3** – Examine current and future instream and out-of-stream water needs
- **Step 4** – Develop and prioritize strategic, integrated solutions to meet multiple water needs
- **Step 5** – Create and approve a local, integrated water resources plan

**Figure 4-1: Key Place-Based Planning Principles**

- Locally-initiated and led collaborative process
- Voluntary, non-regulatory approach
- Includes a balanced representation of water interests
- Conducted in partnership with the state
- Addresses instream and out-of-stream needs, including water quantity, quality and ecosystem needs
- Utilizes an open and transparent process that fosters public participation
- Facilitates implementation of local solutions
- Builds on and integrates existing studies and plans
- Does not jeopardize existing water rights
- Recognizes the public interest in water
- Consistent with the principles in the Integrated Water Resources Strategy, and state laws and policy

## Legislation

In 2015, the Oregon Legislature supported place-based approaches to water planning by giving the Water Resources Department authority to issue grants, enter into contracts or agreements, and provide technical assistance to support development of local strategies and solutions.

According to the legislation (Senate Bill 266)[2], place-based integrated water resources strategies must:

- Be developed in collaboration with a balanced representation of interests
- Balance current and future instream and out-of-stream needs
- Include the development of actions that are consistent with the existing state laws concerning the water resources of this state and state water resources policy
- Facilitate implementation of local solutions
- Be developed utilizing an open and transparent process that fosters public participation
- Be developed in consultation with the (Water Resources) Department

## Providing Financial Assistance to Communities

The 2015 Legislature allocated $750,000 to the Water Resources Department to assist communities with planning. The authority to provide grants to support place-based planning is currently set to expire in 2019.

In late 2015, the Water Resources Department solicited letters of interest from communities that wanted to undertake collaborative water planning using the place-based planning framework. More than 80 individuals and organizations responded with inquiries, and by the end of the two-month solicitation period, 16 communities had submitted letters of interest requesting more than $3.6 million. Four places were selected to receive grants, with two communities receiving the full amount requested and two communities receiving partial funding. These communities have been able to leverage this funding to pursue significant in-kind and cash contributions greater than the state's original investment.

### Providing Technical Assistance to Communities

In addition to financial support, state agencies are providing technical assistance to the planning groups. The state hired two coordinators to support planning groups by: administering funding; offering guidance; connecting the planning groups to information, expertise, and resources; coordinating technical assistance from the Department; and serving as a partner in the planning process.

Multiple state natural resources agencies – primarily Water Resources, Fish and Wildlife, Agriculture, and Environmental Quality – are contributing their time and resources to the planning efforts and working to better integrate agency efforts at the local level.

Bringing together state agencies and local partners through planning creates a testing ground for the wide range of recommended actions described in 2017 Integrated Water Resources Strategy. From land-use practices to natural resources management and emergency preparedness, communities are well positioned to build trust, hold difficult conversations, and make progress on issues beyond what state agencies can do on their own.

Place-based planning has improved inter- and intra-agency coordination and has improved access to agency data and information. It has also created venues to share local knowledge and agency expertise about water issues. Continued investments in technical assistance are critical to ensure agencies can partner with communities and provide ongoing support.

### Communities Undertaking Place-Based Planning

The four communities that received financial assistance to test the Draft Planning Guidelines are:

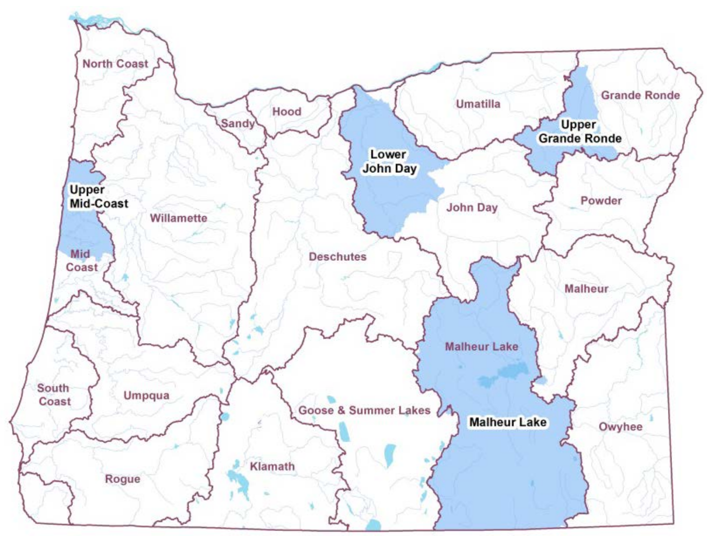
**Upper Grande Ronde River Sub-Basin –**
Convened by Union County

**Lower John Day River Sub-Basin –**
Co-convened by the Gilliam Soil and Water Conservation District and the Mid-John Day Bridge Creek Watershed Council

**Malheur Lake Basin –**
Co-convened by the Harney County Watershed Council and the Harney County Court

**Mid-Coast Region –**
Co-convened by the City of Newport and the Water Resources Department

**Figure 4-2: Place-Based Planning Areas**




Consistent with the spirit of a place-based approach, the planning process and plans will look different for each place. All four communities face unique water challenges, are convened by different entities, and have diverse partners that see the spectrum of water needs in their watersheds differently. Using the state's planning framework, all of the groups have brought together individuals and organizations representing instream interests (such as fish and wildlife needs and recreation), out-of-stream interests (such as agriculture, municipalities, domestic, industry), as well as representatives from local, state, federal, and tribal governments.

These planning groups, in partnership with the state, are building their capacity to collaboratively solve water problems, improve coordination of existing information and plans, foster partnerships among different water sectors and water users, leverage public and private investments to maximize impact, engage the broader public in community conversations about water, and encourage continuous improvements in water planning and management. Place-based planning can help Oregon communities identify and develop widely supported project concepts that can meet multiple needs. Projects that are collaboratively developed and that yield social, economic, and environmental benefits will have a competitive edge for implementation funding.

### Challenges Faced by Oregon Communities

Although any community is welcome to use the Draft Planning Guidelines and pursue a place-based approach to water planning, a recent survey found that communities face a number of challenges in doing so. Of the places that did not receive financial support from the state, all of them continue to express an interest in and need for collaborative water planning. The need has been intensified by consecutive years of drought, recent floods, heavy snow, wildfires, and a greater recognition of aging infrastructure. Despite sustained interest, there are four primary challenges that hinder communities from initiating place-based planning:

**Limited funding –** It is difficult to find and secure sufficient funding to sustain a multi-year collaborative planning effort.

**Limited coordination capacity –** Bringing people together and making sure they are coordinated requires a significant institutional investment and not every organization has the capacity without additional support.

**Too many competing demands –** Local leaders are pulled in many directions responding to different competing needs in their communities. Water planning is one of many priority issues that require attention.

**Lack of information or knowledge –** Some areas still lack critical data and information, which limits our ability to understand and address complex problems. Although there may be multiple sources of information, it can be challenging to access and interpret available data and information.

### Actions for the Next Five Years

The communities currently piloting place-based planning should be supported in various ways to achieve successful outcomes and implementation of practical, local solutions. Having access to professional facilitation, increasing access to financial and technical resources, and creating peer-to-peer learning opportunities are already emerging as lessons learned and best practices.

As planning progresses, the Department and its partners will gain valuable insights from these first efforts. The state should review and update the planning guidelines to reflect what has been learned and share with other interested communities and stakeholders.

The state should research how other states across the nation, as well as other countries, support integrated water resources planning at the local level and how that differs from Oregon's approach. The state should also seek to better understand the challenges and barriers that communities face in planning for their water future and continue to engage communities beyond the current planning areas that would like to develop a plan but lack

**Recommended Action 9.A**
**Continue to Undertake Place-Based Integrated Water Resources Planning**

Examples of how to implement this action:

- Promote success by continuing to support the places currently following the draft planning guidelines
- Continue to provide financial and technical assistance to support collaborative water planning
- Promote peer-to-peer learning between communities pursuing collaborative water planning
- Assess and review efforts thus far, soliciting input on place-based planning, refining planning guidelines, and implementing process improvements

the necessary resources.  Planning groups should continue to actively provide input and feedback to statewide leaders about how the state can support them in their planning efforts.

Over the next five years, public and private partners should continue to play an active role in shaping a place-based approach to water planning.  In order to succeed, place-based planning must be championed by local leaders and supported by instream and out-of-stream interests across the state.  It will require new partnerships, creative approaches to problem-solving, a continued commitment to improved coordination and integration, and sustained investments from the public and private sectors.  In November 2017 the Meyer Memorial Trust granted two communities, the Mid-Coast and Harney County, $120,000 each for an additional year of place-based planning.

## Coordinate 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.

Within a basin or sub-basin, multiple planning documents that involve water management, directly or indirectly, may exist.  These plans may be contradictory or complementary.  Coordination of these plans could lead to improved collaboration, resulting is greater benefits for natural resources.

Water management and conservation plans (by a municipal water provider, or irrigation district); fish conservation and recovery plans; biological opinions; basin plans for water allocation; Total Maximum Daily Load plans for improving water quality; water system master plans; 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 large number of agencies and entities at every level.

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

Examples of how to implement this action:

- Coordinate and reconcile existing planning documents
- Dedicate resources for state and local implementation of existing plans

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 water planning, 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.  To assist, the state should dedicate resources for implementing actions contained in existing planning documents.

## Partner 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's management of water resources.  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 information sharing are just a few areas where new partnerships can benefit water planning and management.

### 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 resources management, land management, and therefore, water resources management is significant. State and federal agencies often work together on cooperative studies, such as groundwater basin studies, discussed in Chapter 1.

Another example is the use of federal Biological Opinions. Watersheds throughout Oregon are host to a number of threatened, endangered, and sensitive species. Biological Opinions set objectives for species protection by laying out actions to protect, enhance, or restore conditions for these species and their habitat. Several federal and state agencies participate in the Willamette Action Team for Ecosystem Restoration to carry out and coordinate actions in the 2008 Willamette Biological Opinions.

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 management of critical pieces of water infrastructure, among them, federal reservoirs that store water for patrons of irrigation districts 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 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 legal government-to-government relationship with tribes through both executive action and legislation.

With regard to water, these relationships often revolve around cultural and natural resource 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 address federal reserved 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*.[3] 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 the border can manage the resource effectively.

Oregon should continue to work with neighboring states to ensure sustainable management of surface water and groundwater resources.

Oregon has been engaged in discussions with the State of Washington to pursue opportunities that include potential long-term investment partnerships to construct new above-and below-ground storage facilities. Discussions could also include coordinated permitting and regulatory approaches, and the protection of streamflow across state boundaries.

### United States, Canada, and Tribes: Columbia River Management

The Columbia River Treaty between the United States and Canada was ratified in 1964, bringing significant management efforts for flood control and power generation benefits to both countries. The year 2024 marks the end of pre-paid flood control space from Canada. Either Canada or the United States can provide notice to renegotiate provisions of the Treaty up to complete termination, with a minimum of 10 years written advance notice, making 2014 an 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, conducted a multi-year effort to study these post-2024 Treaty issues. This effort was called the 2014/2024 Columbia River Treaty Review. Stakeholders embarked on a campaign to elevate the subjects of water supply and ecosystem needs into the top tier of discussion items. Those issues were included in the *U.S Entity Regional Recommendations for the Future of the Columbia River Treaty after 2024*, which recommended that the United States pursue a number of modifications to the Columbia River Treaty, along with some unresolved domestic matters.[4] The U.S. Department of State is now leading efforts for updating the Columbia River Treaty.

In a separate but parallel process, the U.S. Army Corps of Engineers, Bonneville Power Administration, and Bureau of Reclamation (or Action Agencies) are working to prepare an Environmental Impact Statement under the National Environmental Policy Act for the Columbia River System. The three federal agencies will work with various state and federal agencies to develop and examine a reasonable range of alternative river operations. An Environmental Impact Statement is slated for completion in late 2021.

### 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[5] and Klamath Hydroelectric Settlement Agreement[6] in February 2010. These agreements set signatories on a path to comprehensive solutions for the Klamath Basin.

However, Congress did not enact authorizing legislation and the Klamath Basin Restoration Agreement expired in December 2015.

The Restoration Agreement was 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.

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

Examples of how to implement this action:

- Protect Oregon’s interests in shared surface water and groundwater basins
- Negotiate agreements such that water protected instream is shepherded across state lines to the mouth of the river
- Partner with neighbors and tribes to continue or improve access to additional sources of water

The Klamath Hydroelectric Settlement Agreement has been amended twice and continues to be in place. The Agreement 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. The four hydroelectric dams on the Klamath River, one in Oregon and three in California are being transferred to a private corporation for decommissioning in 2020.

# Critical Issue – Water Management and Development

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 described further in this section: water-use efficiency and conservation, built storage, water reuse, non-traditional techniques, water resources development, the importance of a strong field presence, and strengthening our water permitting programs.

## Improve Water-Use Efficiency and Water Conservation

One of the more widely recognized approaches to managing demand for water—and stretching supplies of water—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, adding faucet aerators to bathroom and kitchen sinks, or installing low flow showerheads to use less water are fairly common activities today.

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 1.5 trillion gallons of water and $32.6 billion in water and energy bills. In Oregon, more than 35 organizations, including non-profits, drinking water providers, and various distributors promote WaterSense labeled products. [7]

Land management techniques, such as xeriscaping, 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.

### Water Conservation within Cities

Decreased water demands across several of Oregon's urban communities have emerged as a trend in recent years. Water providers in the Portland Metro area indicate that water demands at 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 reductions, but it is likely a combination of multiple factors, such as wetter summers, loss of manufacturing industry, and water conservation programs taking effect.

The Water Resources Department requires water utilities to examine conservation-based rate structures as part of their Water Management and Conservation Plans. As a result, some utilities have modified their water rates, further driving down demands for water. In a 2014 survey conducted by the League of Oregon Cities, 28 percent of responding cities reported the use of inclining block rates, which is the rate structure typically used to effect water conservation behavior.[8]

Many water providers in Oregon offer rebates for the purchase and installation of water efficient appliances; some also provide shower timers and leak detection kits free of charge to homeowners and businesses alike. 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.

### Water Conservation within Industry

Water conservation in business and industry not only saves money by using less water, it can also save on energy required to heat water and run equipment. In manufacturing operations, service and retail establishments, and other businesses, there are ample opportunities to use water efficiently. Just like in the home, water-efficient toilets, faucets, showerheads, clothes washers, and dishwashers can save significant amounts of water.

Water-intensive industries in particular have an opportunity to use more efficient processes, or even recycled water, for washing or flushing, in industrial processes, in chillers, and in cooling towers. Some businesses also take the opportunity to convert their greenspaces to xeriscapes, or to install weather-based irrigation systems to improve irrigation efficiencies.

Several water providers offer walk-through inspections to help commercial customers detect leaks or develop additional water-saving ideas.

### Water Conservation within Agriculture

Agriculture is the largest user of water in Oregon. Statewide efforts should focus on increasing voluntary conservation and efficiency efforts in the agriculture sector. This could result in significant water savings statewide. Although barriers to water conservation exist, there are several water conservation and efficiency technologies already in use that are particularly helpful to agriculture.

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 more efficient irrigation systems, including weather-based irrigation systems, soil moisture controls linked to weather data and computer controlled irrigation, drip irrigation, variable speed pumps that adjust to water-use needs, and piping or lining canals. Several irrigation districts, particularly in Central Oregon, have improved their water delivery systems through lining and piping projects to better manage water supplies.

Other agricultural technologies that facilitate 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.

The most recent Farm and Ranch Irrigation Survey, developed by the U.S. Department of Agriculture's (USDA) National Agricultural Statistics Service, shows Oregon irrigated an estimated 1.55 million acres of cropland in 2013.[9] The 2013 Survey reports Oregon producers applying, on average, 1.9 acre-feet of water per acre to grow their crops. By comparison, Washington applies 2.3 acre-feet, Idaho applies 1.8 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 forfeiting water rights.

The potential for reduced return flow or injury to other water users are also factors to consider when designing a water conservation project. Piping, lining, or other water efficiencies can greatly reduce the quantity and rate of return flows that traditionally make their way back to the stream. However, return flows can also be a major source of nutrient, sediment, and thermal loading to waterbodies. Some Water Quality Management Plans call for a reduction in return flows for that very reason.

A number of resources exist to help water users make water-use efficiency gains. The Bureau of Reclamation offers competitive grants for water and energy efficiency projects. Since 2004, Reclamation has awarded more than $18.5 million primarily to irrigation districts for piping or lining canals and ditches, and installing telemetry systems and related micro-hydro projects.[10]

Other funding sources are available from USDA's Natural Resources Conservation Service and Oregon Water Resources Department.

**Highlight Box**

**Modernizing Oregon's Irrigation Infrastructure**

Upgrading aging irrigation infrastructure is one of the greatest opportunities to meet Oregon's growing water needs. Additionally, irrigation modernization provides opportunities for hydropower generation, facilitates ecological restoration, and spurs economic development. Oregon's agricultural water users store, release, and divert water through a system of up to 125 year-old reservoirs, canals, and laterals. Many of these canals and laterals were dug by hand, lose water through seepage and evaporation, and create water management challenges for both out-of-stream and instream uses.

Through the Irrigation Modernization Program, Farmers Conservation Alliance (FCA) and the Energy Trust of Oregon partner with irrigation districts to:

- assess water conservation potential
- identify opportunities to conserve or produce energy
- examine the co-benefits to the environment, the economy, and communities
- develop a comprehensive system improvement plan
- identify and secure the resources to implement the plan

Districts like Swalley Irrigation District helped to create the model for the Irrigation Modernization Program. With a mix of federal, state, and private funding, Swalley Irrigation District and its partners have converted 10 of its 28 miles of open canals to pipelines and built a three-quarter megawatt hydropower facility, taking advantage of water on its way to farms. Swalley uses revenues generated from the carbon-free, fish-friendly renewable energy to pay off their modernization investments and fund future projects. The efficiencies created by the new pipelines mean that 4.1 billion gallons of water per year are now legally protected instream for fish, recreation, and the community at-large.

In 2016, the Clean Energy States Alliance, a national coalition of public agencies and organizations working together to advance clean energy, recognized FCA and the Energy Trust of Oregon's innovative work with the State Leadership in Clean Energy Award.

"The work done by the Farmers Conservation Alliance is a powerful example of how irrigation modernization can address multiple challenges and provide multiple benefits. The potential exists over the next decade for irrigation districts across the state to upgrade to more modern infrastructure, saving water, restoring streams and generating green, renewable energy. These investments in irrigation systems are also investments in the future resiliency, competitiveness and livability of Oregon's rural economies."

- Senator Jeff Merkley

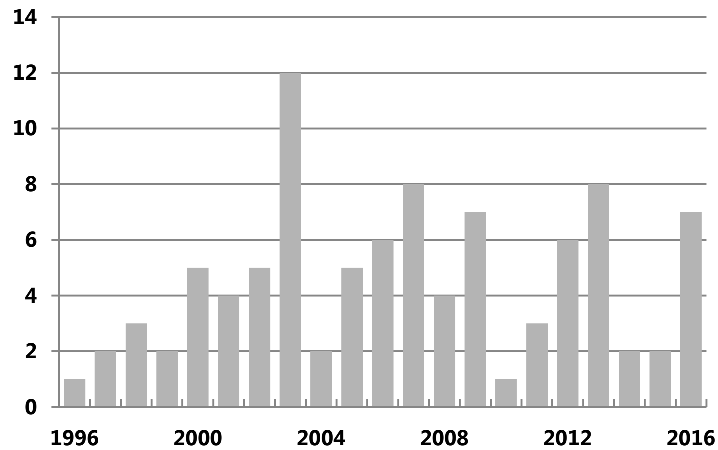
Find more information at: http://irrigationmodernization.fcasolutions.org/

## Existing State Tools for Water Conservation

**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 or leaky canals or ditches, or changing from a less efficient water distribution system, such as flood irrigation, to sprinkler or drip irrigation.

Since 1996, the Water Resources Department has received 96 applications for conserved water projects. More than 179 cubic feet per second (cfs) has been protected instream as a result of these water conservation/efficiency projects, and an additional 131 cfs of water has been made available for cultivation of additional farmlands.

**Figure 4-3: Allocation of Conserved Water Applications**
(1996-2016)




As a result of recommendations in the 2012 Strategy, this program has overhauled its forms and materials, making the program more accessible and understandable to users. However, recent surveys show that many irrigators and technical irrigation experts are still unaware of this program, or the benefits it can provide 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 —** 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 certain 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.

**Future Water-Use Efficiency and Conservation Programs —** Water users in Oregon have many tools available to encourage water conservation and more efficient use of water resources. However, the state does not have a coordinated program to promote such tools. Establishing a water-use efficiency and conservation program at the state level that provides technical assistance to water users in all sectors is needed. This was especially evident during the 2015 drought, as the state lacked resources to do effective outreach and education.

Developing such a program could include creating a user-friendly website, conservation materials for use by public and private partners, an on-line clearinghouse that highlights best management practices, funding, and technical resources. A clearinghouse could help water providers identify the potential for conservation and then design or improve their programs.

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

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 makes sense. Lastly, because water and energy are so closely tied, water conservation goals and efforts should be coordinated with energy efficiency programs. Below are two examples of state efforts to reduce energy and water use.

**Removal of Irrigated Landscape on I-84 —** The Wallowa Lake interchange on I-84 in La Grande is the site of a project by the Oregon Department of Transportation, District 13, replacing the grass with landscape rock. In 2015, at the height of Oregon's drought, irrigating the nearly five acres of grass took almost 5.4 million gallons of water, costing more than $13,000. Mowing the grass all summer cost thousands of dollars more. In future years, no water will be needed. The total cost of the rock was less than $100,000, which will be recouped in less than seven years—and save millions of gallons of water in the process.

**Net Zero Water System at Camp Rilea —** Camp Rilea, a military training facility in Warrenton, has created a net zero water system, resulting in its selection as an Army Net Zero Water Pilot Installation. Camp Rilea pumps groundwater onsite, treats the water to potable water standards at its water treatment plant, delivers the water throughout the installation for use, discharges to a wastewater treatment plant, and then pumps the treated effluent and captured stormwater to rapid infiltration basins to recharge the groundwater. Currently, Camp Rilea injects as much water through the rapid infiltration basins as what is pumped from groundwater for potable use, making Camp Rilea "net zero" for water use. Other specific projects implemented at Camp Rilea include: development of a Water Management and Conservation Plan, supply system and plumbing upgrades, wastewater treatment plant upgrades and modifications, expanded use of recycled water for irrigation, and conversion of irrigated turf to native meadow.

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

Examples of how to implement this action:

- Establish a water-use efficiency and conservation program that provides technical assistance to water users in all sectors
- Conduct a statewide water conservation potential assessment
- Prioritize agricultural water-use efficiency and conservation
- Develop an outreach strategy to expand participation in already-existing water-use efficiency and conservation programs

## Improve Access to 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 in reservoirs. Another 5,000 ponds were registered with the state in the mid-1990s. 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.[11] 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 regarding 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

Oregon can improve access to groundwater storage by encouraging the increased use of Aquifer Storage and Recovery (ASR) and Artificial Recharge (AR) for water storage. The use of these techniques is gaining interest, particularly in the northwest and north central regions of Oregon, due to the smaller environmental footprint, moderate cost, and potential associated benefits for water quality. Areas of the state designated as "groundwater limited" or "critical groundwater areas" may have greater capacity to develop ASR and AR projects.

Forming partnerships between different user groups, such as a municipality that treats water and an irrigation district needing an alternative source of water could help meet the financial and water quality obligations for ASR injection. The Water Resources Department may need to develop technical materials to help communities decide if such projects are worth pursuing. Grants for feasibility studies, discussed later in this chapter, have been used to explore potential aquifer storage projects. In 2016, the Department provided grants to Clean Water Services to study the feasibility of developing a stormwater ASR project in Beaverton. If deemed feasible, the stored stormwater would be recovered from an existing ASR well and used for irrigation during the summer months.

The Department of Environmental Quality, Department of Fish and Wildlife, and the Oregon Health Authority also play a role in ASR/AR projects. Water that is treated to standards safe enough for drinking water is the only source water allowed for ASR projects. Direct injection of water must be geochemically compatible with natural groundwater as well. This protects the groundwater resources, but can be an expensive standard to meet, particularly for non-municipal projects with large tracts of land.

The state has issued authorizations to 19 entities for testing the use of ASR and six for AR. 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. Figure 4-4 compares both technologies.

| Figure 4-4: Comparing Artificial Recharge and Aquifer Storage and Recovery Technologies | | |
|---|---|---|
| Category | Artificial Recharge (AR) | Aquifer Storage and Recovery (ASR) |
| 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 |
| Oregon Revised Statutes (ORS)<br>Oregon Administrative Rules (OAR) | ORS 537.135<br>OAR 690-350-0120 | ORS 537.531 to 537.534<br>OAR 690-350-0010 to 690-350-0030 |

## Above-Ground Storage — Reservoirs

Most storage water rights are for small ponds or reservoirs, those that store less than 9.2 acre-feet or with a dam less than 10 feet in height. The largest facilities are federal storage projects, including the U.S. Bureau of Reclamation's Owyhee Reservoir in southeastern Oregon with more than one million acre-feet of storage.

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 –** The Willamette Basin Project, a series of 13 dams and reservoirs, is owned and operated by the Army Corps of Engineers and can legally store 1.64 million acre-feet of water. 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.

The U.S. Bureau of Reclamation currently holds water right certificates to store water for irrigation use only. Reclamation is authorized to issue irrigation contracts; however, total contracts cannot exceed 95,000 acre-feet, according to the 2008 Willamette Biological Opinion. The water rights do not authorize stored water for municipal use or instream uses.

The Corps of Engineers, which owns and operates the Willamette Valley Project reservoirs, is conducting a feasibility study in the Willamette Basin. The Water Resources Department is sponsoring this three-year study, which will quantify the current use of storage and identify future water needs for irrigated agriculture, municipal, industrial, and instream uses in the Willamette River basin. The study's goal is to examine whether operational changes or modifications in the storage allocation from the Willamette Valley Project reservoirs would better serve present and future water needs in the basin. The study is scheduled to be completed in late 2018.

Similar conversations have occurred in the Crooked River basin to manage uncontracted stored water in Prineville Reservoir to meet increasing demands for fish and wildlife and other uses. Prineville Reservoir, southeast of Prineville on the Crooked River, was built by the Bureau of Reclamation in 1960 and was originally authorized for irrigation and flood control.

Congress passed the Crooked River Collaborative Water Security Act in December 2014.[12] This Act made revisions to the allocation of the water stored in Prineville Reservoir. The water right certificate allows Reclamation to store 155,000 acre-feet annually. The Act limits irrigation to 81,013 acre-feet, allows 5,100 acre-feet for the City of Prineville to use for mitigation of a new municipal groundwater permit, and the balance of uncontracted water to be released to support downstream fish and wildlife. This Act has created a storage system with more flexibility to meet a broader array of uses.

Currently, the U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, Water Resources Department, the Department of Fish and Wildlife, and the local irrigation districts are developing management plans and operational procedures to reflect the 2014 legislation.

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.

The United States Congress' recent reauthorization of the Bureau of Reclamation's Safety of Dams program will provide multiple public benefits for storage in the Tualatin Basin. This authorizes Reclamation to integrate dam safety improvements with additional benefits, such as conservation storage. Water providers in Washington County will use this opportunity to secure seismic upgrades for Henry Hagg Lake, while expanding the capacity of the lake to meet the region's water needs.

**Identifying Non-Traditional Storage Sites –** The Water Resources Department created an inventory of potential reservoir sites from past surveys conducted by different entities.[13] The purpose of developing the inventory was to create a clearinghouse of storage information. However, no attempt was made to assess the ecological or economic feasibility of these sites. The Department has provided this information so that communities can avoid "reinventing the wheel," in terms of site investigation.

Most of these potential dam sites in the inventory are located on major stream channels. Since the time of these surveys, Oregon has moved away from locating dams on significant stream and river channels, in large part because of effects on fish and aquatic life that must migrate through these streams. There has been very limited evaluation of above-ground storage sites that are located off-stream, on very small stream channels, or at sites with little or no effect on migration of fish and other aquatic life. Additional work is needed to locate potential reservoir sites in these more favorable locations.

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 that also provide benefit to fish and wildlife species and water quality.

**Evaluating Storage Infrastructure –** Oregon should evaluate the status of its existing storage capacity and infrastructure, including determining the maintenance and rehabilitation needs of dams. To improve access to stored water, Oregon should continue to support the Dam Safety Program, and identify ways to expand the capacity of existing above-ground storage projects—by raising a dam's height, removing sediment, or repairing the dam where safety restrictions have required lower water levels.

**Reserving Water for Future Economic Use –** A reservation sets aside unappropriated water for storage to meet future needs. Although it assigns a priority date, it is not the same as a water right application or permit. For example, approval of a reservation does not mean that any future application will be approved, or that a reservoir may be constructed. Water users wishing to appropriate reserved water must submit a water use application to the Water Resources Department, referencing the reservation. The Department then reviews the application based on current, applicable public-interest review standards.

During the 1990s, the Department of Agriculture requested reservations of water for future economic development, focusing primarily on the needs of agriculture. The reservations were originally approved for a period of 20 years, and were extended by the Water Resources Commission during 2015-16.

Reservations are in place in six basins: Grande Ronde, Hood River, Malheur, Malheur Lake, Owyhee, and Powder River, and are established by rule in basin programs. Each program's rules govern the appropriation and use of the surface and groundwater within the state's major river basins. These programs supplement statewide rules governing water use and allocation.

**Recommended Action 10.B**
**Improve Access to Built Storage**

Examples of how to implement this action:

- Encourage increased use of below-ground storage sites
- Re-allocate water in federal reservoir systems that have not undertaken formal allocation processes in Oregon
- Investigate potential off-channel sites for above-ground storage projects
- Evaluate the status of storage infrastructure, including the maintenance and rehabilitation needs of reservoirs
- Incorporate existing reservations of water into planning efforts

## Encourage 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. 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, Department of Fish and Wildlife, Water Resources Department, and Department of Consumer and Business Services (Building Codes Division), are all involved in different aspects of water reuse projects and proposals.

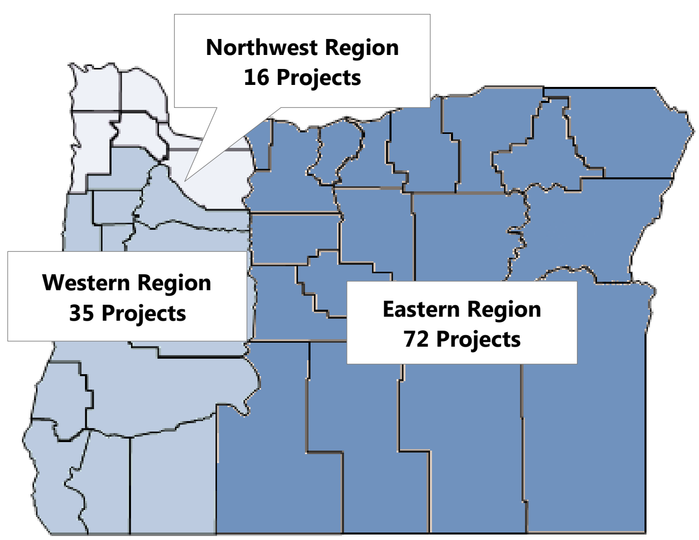
The Department of Environmental Quality (DEQ) is the lead agency in regulating the use of reclaimed water (called "recycled water" at DEQ). In consultation with the Department of Fish and Wildlife, DEQ determines whether the use would be beneficial to listed fish species and instream flow targets. The Water Resources Department determines whether the reclaimed water use would cause harm to other water rights; it also tracks the reclaimed water use in the Water Rights Information System database, noting the source of the water and where and how the water will be reused. Oregon Revised Statute 537.132(6) requires that the Water Resources Commission adopt and implement a set for rules for reclaimed water. Rulemaking for municipal water reuse/reclaimed water began in 2017.

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.

**Figure 4-5: Recycled Water Projects by DEQ Region**



- **The Use of Recycled Water –** Recycled water refers to treated effluent from a municipal wastewater treatment facility. Oregon has approximately 340 wastewater treatment facilities and there are more than 120 municipal facilities operating recycled water programs throughout the state, see Figure 4-5. Four classes of recycled water, based on various levels of treatment, can be reused for specific beneficial purposes. Communities have been taking advantage of State Revolving Fund loans for developing and upgrading recycled water systems, with seventeen such requests in 2009 alone.

- **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 have been traditionally limited to non-drinking water purposes, a wide-range of activities can occur, including irrigation of crops and pastureland and irrigation of urban landscapes. Cities commonly use recycled water to irrigate golf courses, athletic fields, and business parks. Recycled water can also be used for industrial cooling, dust control, street sweeping, and artificial recharge of groundwater.

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.

Reusing water can provide many benefits to both water quantity and quality. Water quality can be improved by the reduction of discharged treated effluent, such as a municipality treating wastewater and recycling it for irrigation. It can also provide a benefit to water quantity by reducing the demand on drinking water sources, for example, 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

Launched in Oregon in 2015, the Pure Water Brew annual competition has brought together beer homebrewers with the goal of building awareness around the benefits of recycled water. Highly purified water from Clean Water Services wastewater treatment plant is used to make beer for the competition. Clean Water Services was required to obtain approval for direct potable reuse by the Oregon Health Authority and the Environmental Quality Commission; both agencies approved the request in early 2015. In 2017, there were 40 brewers competing in the Sustainable Water Challenge/Pure Water Brew challenge. Direct potable water reuse for brewing is catching on in other states. Wastewater utilities in Arizona, Florida and Wisconsin are now hosting similar brewing competitions.[14]

In the summer of 2016, the West Extension Irrigation District began receiving recycled Class A Water from the City of Hermiston Recycled Water Treatment Plant. Discharge regulations designed to protect salmon in the Umatilla River during summer restricted warm discharge from the City, while at the same time, the irrigation district was seeking an additional source of irrigation water.

Working closely with the U.S. Bureau of Reclamation, Oregon Department of Environmental Quality, the Confederated Tribes of the Umatilla Indian Reservation, and other partners, the city and irrigation district designed an arrangement that addressed the needs of member irrigators, citizens, and regulators alike. Utilizing a $27 million Membrane Bioreactor Treatment System, the city is producing water that is virtually indistinguishable from drinking water quality. The resulting water is suitable for direct use on all food crops, including organically labeled produce. The Water Resources Department awarded the City of Hermiston and the West Extension Irrigation District the Tyler Hansell Agricultural Efficiency Award in 2017 for their reclaimed water project.

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, testing the water quality, and 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, and is, clearly communicating water reuse policies, procedures, and regulations, giving due consideration to the protection and augmentation of instream flow, as well as protection of water quality, public health, and drinking water sources. Oregon should also consider providing financial or technical incentives to increase and to track water reuse for municipal, industrial, and agricultural uses.

**Recommended Action 10.C**
**Encourage Additional Water Reuse Projects**

Examples of how to implement this action:

- Conduct a statewide assessment of the potential for additional water reuse
- Ensure that state agencies coordinate and communicate various policies, procedures, and regulations to facilitate reuse projects
- Provide incentives to increase and track water reuse

## Consider Non-Traditional Approaches to Meeting Water Needs

Storage and water conservation are a set of traditional tools for meeting water needs. 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, and think holistically about better ways to meet water quality, water quantity, and ecosystem needs.

### Desalination

Desalination is a technique that allows communities to stretch limited supplies in both inland and coastal communities by removing salt using reverse osmosis from brackish groundwater or surface water. This technique is used in more than 100 countries—most prominently throughout the Caribbean, Mediterranean, and Middle East. Communities in Florida and California are constructing or have constructed desalination plants.

Some of the greatest challenges to implementation include: intense energy requirements to treat the water; expansive coastline to site an energy source, pumps, pipes, inflows, and outfalls; damage to marine organisms during water intake, and brine disposal options. These challenges make desalination one of the most expensive sources of potable water.

Such projects would need to seek approval through existing regulatory pathways, and where appropriate, planning groups may need to identify barriers to desalination projects. Identification of these barriers would help the state examine policy changes or mitigation options where appropriate.

### Water Quality Trading

The Oregon Environmental Quality Commission approved rules in 2015 establishing a voluntary water quality trading program to facilitate pollution reduction and protect the quality of Oregon's waterways. The new rules provide clarity for regulated entities, the public, and Department of Environmental Quality staff.

Public and private partners throughout Oregon continue to work on developing 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 nutrient goals under the Clean Water Act and species habitat needs under the Endangered Species Act. This involves 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, the National Network on Water Quality Trading, and the National Fish and Wildlife Foundation are actively working on developing protocols. These protocols will help DEQ and dischargers make more informed choices about how to meet water quality requirements in more cost-effective ways, such as using riparian shade restoration to help achieve heat reduction requirements.

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

Examples of how to implement this action:

- Assist in the research and development of non-regulatory tools to meet environmental outcomes
- Continue to develop water quality trading programs
- Develop protocols for translating streamflow restoration into credits and accounting strategies

**Highlight Box**

**Restoration for Compliance in the Rogue River and Beyond**

In 2010, the regional wastewater utility for the City of Medford in southern Oregon had a problem. The treated wastewater it released into the Rogue River was too warm for salmon to thrive during migration, spawning, and rearing, putting it out of compliance with the Clean Water Act. Traditional solutions, like diverting water into holding ponds or building cooling towers, were likely to cost $15 million or more.

The City of Medford, Oregon Department of Environmental Quality, and non-profit partners Willamette Partnership and The Freshwater Trust designed a water quality trading program that allows the City of Medford to pay landowners to plant trees along the river to shade and cool the water. The Freshwater Trust, on behalf of the city worked with landowners, nurseries, and other contractors to restore forests that shade the Rogue River and its tributaries, reducing the effect of heat from the sun, filter stormwater runoff, create wildlife habitat, and sequester greenhouse gases. This approach is estimated to have saved the City and its ratepayers more than $8 million.

Clean Water Services pioneered water quality trading and riparian restoration for compliance in the Tualatin River through its 2010 and 2016 watershed-based National Pollutant Discharge Elimination System permits. The City of Medford's program built on that innovation by offering a different model wherein landowner recruitment, project implementation, and project verification were supported by third parties; utilities that are not able or interested in developing restoration projects themselves can still use water quality trading for compliance. As of November 2017, these projects have restored nearly 4.5 miles and 33 acres of native riparian forests, and reduced thermal loading by 420 million kilocalories per day.

The National Network on Water Quality Trading released a comprehensive guide identifying the key components of a trading program. In 2016, the Association of Clean Water Administrators and Willamette Partnership released a set of state water quality trading policy templates to provide a blueprint for other states, cities, or watersheds seeking to create a water quality trading program.

Find information at: http://willamettepartnership.org/our-stories/rogue-river/ - or - https://www.thefreshwatertrust.org/case-study/medford-water-quality-trading-program/ -or- http://www.oregon.gov/deq/wq/wqpermits/Pages/Trading.aspx

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 the concept of streamflow in these accounting strategies.

## Continue to Support a Water Resources Development Program

In recent years, the Water Resources Department has invested in a suite of funding and assistance tools to support communities that are dealing with various water issues—both consumptive and ecological in nature.

Water resources planning, noted earlier as "place-based integrated water resources planning" was highlighted in the first water strategy. Communities needed a way to conduct collaborative water planning at the local level, mirroring the goals and guiding principles of the statewide strategy. In the past, this type of watershed-based planning had only been done in a few places – like the Deschutes and Tualatin Basins – and there was a desire to support it elsewhere. The state drafted water planning guidelines and created a Place-Based Planning Grant program to support new planning efforts. Building a foundation around place-based planning will ultimately result in proposals, projects, or recommendations that are well-vetted by the local community and integrate a variety of instream and out-of-stream benefits and uses.

A separate fund supports feasibility studies, perhaps the most difficult project phase for project proponents to fund. Applicants exploring water conservation, water reuse, or storage can use grant dollars to analyze the technical merits, including the economic and environmental implications or benefits of a project concept. The first Integrated Water Resources Strategy recommended continuation of the Feasibility Study Grant program and it is still in place today.

Finally, the state recognizes a need to support implementation of water projects, and has created an account to fund projects that provide economic, environmental, and social or cultural benefits. While modest in comparison to other states, these investments can be leveraged with other federal or private sources to implement water projects that yield multiple benefits. This fund can also be used as match funding for federal programs like the Bureau of Reclamation's Basin Studies program that taps federal resources and expertise to conduct large-scale studies. Water Project Grants and Loans are discussed in greater detail later in the chapter.

The three elements—water planning, feasibility, and implementation—make up the state's Water Resources Development Program. The program was designed knowing that communities are at different stages of the planning/project spectrum. As they work to meet the water-related needs of humans and the environment, such communities will need partnership and technical resources all along this continuum.

**Recommended Action 10.E**
**Continue the Water Resources Development Program**

Examples of how to implement this action:

- Identify opportunities for the state to serve as a partner in water resources projects
- Seek out additional technical resources
- Find additional federal, state, private, and other match funds

## Provide an Adequate Presence in the Field

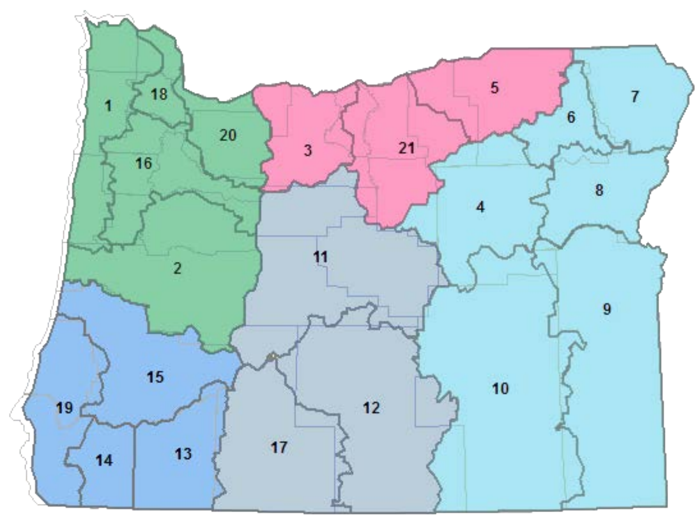
A number of Oregon's natural resources agencies have personnel in the field. The ability to partner with the community and work on the ground is one area that sets Oregon apart from other states that have written policies, but have limited capacity to implement or enforce them out in the field.

The Secretary of State's 2016 performance audit of the Water Resources Department underscored the importance of field staff by finding that, "Growing and changing demands coupled with a limited number of field staff impact WRD's capacity to effectively monitor and regulate Oregon's water supply. Field staff coverage overall has steadily declined and there have been some extended gaps in time where positions were vacant. Field staff have to cover a vast geographic region and associated workload. OWRD should regularly assess field staff workload to ensure it aligns to resources and that staff time is dedicated to critical responsibilities."

Field personnel collect data—including hydrological, biological, and chemical data—and protect public and environmental health through inspections and enforcement actions. Field personnel 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 with broad and deep knowledge of policy, technical, and legal expertise in their disciplines. They are the state's first responders to requests for help or information and are an integral part of the fulfilling agencies' statutory authorities

Field staff are important for protecting the rights of water users as well as protecting the public interest. While in the field, staff collect data, taking samples and measurements of groundwater and surface water. Field-related work also involves installing and calibrating water measurement and monitoring equipment.

**Figure 4-6: OWRD Watermaster Districts**




Field personnel conduct site inspections, confirm compliance with permit conditions, guard against waste and contamination, inspect for hazards, and pursue enforcement actions when necessary. Finally, and perhaps most importantly, they are available to respond to requests for information and to provide public education year-round. The state's watermasters, biologists, water quality specialists, basin coordinators, and other field staff have a unique opportunity to strengthen ties and build relationships with local communities.

**Water Resources Department –** The Water Resources Department has 167 staff, with approximately one-third located in field offices throughout the state. This is supplemented by about a dozen full-time and part-time county-funded assistant watermasters and hydro-technicians. Compare this to Portland Water Bureau, with about 580 staff, or the City of Bend, with 73 water, wastewater, and stormwater staff. The Owyhee Irrigation District in southeastern Oregon has 11 ditch riders, two full-time dam tenders, and two watermasters of their own to support water management of 118,000 irrigated acres.

At the Water Resources Department, field personnel implement Oregon water law and the Doctrine of Prior Appropriation. Under this Doctrine, it is the responsibility of field personnel—the state's watermasters and assistant watermasters—to regulate and distribute water, curtailing the water use of junior water right holders during times of water shortage.

The Department's limited field presence is noteworthy, given the large geographic territory and growing number of 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, the largest district in the state. Responding to a call for regulation at one end of the District can require an entire day's travel. In northwest Oregon, the District 16 watermaster oversees several hundred dams of various sizes and configurations that need routine inspection and site visits. In this district alone, there are 14,700 water rights that authorize the use of groundwater, surface water, and storage for a variety of uses. More than 12,000 of these water rights authorize more than 553,000 acres of primary and supplemental irrigation.

The Water Resources Department is undertaking a process to internally audit its workload and priorities in the field, re-distributing assignments as necessary to focus on mission-critical needs, given the available resources.

**Training –** Investing in field activities means more than just increasing the number of staff; it also refers to investing in their technical training, their level of skill, and distribution of workload. A significant amount of technical training is invested in each member of the field staff. The equipment and software used on the job are constantly becoming more sophisticated. Mastering these new tools and technologies will require additional education, training, and certification. Agencies also see the benefit of cross-training staff in the field, so that employees are familiar with multiple issue areas and can assist in the work of other staff or even in other Districts.

**Regulatory Tools –** As the demand for water grows and water supplies become further limited, the job of field staff becomes even more difficult. Field staff confirm that water right holders are using water according to their permits, and respond to complaints of interference or illegal water use. The field closely monitors streamflows and then manages the system accordingly to meet the call for water by senior water right holders.

The legal and statutory framework underpinning these activities needs to be up-to-date, clear, and responsive enough to keep up with modern day water use. This includes improving property access agreements, and making enforcement tools more nimble. In a similar vein, technology that is available to field staff (information, equipment, communications platforms, and transportation) must be efficient and accessible in order to be useful.

Communities have strong compliance with rules and laws in areas where field presence is robust and public education is strong and consistent. Areas of the state with a long tradition of regulation and partnership with the state have higher rates of compliance, resulting in more timely and efficient water management.

**Coordination and Communication –** Strengthening Oregon's field-based work will require financial investments in communications equipment, information platforms, and outreach materials. It also means a look at more efficient ways to coordinate and partner with other agencies to carry out our shared responsibilities.

The Department of Fish and Wildlife and Water Resources Department are examples of partners. ODFW field staff

**Recommended Action 10.F**
**Provide an Adequate Presence in the Field**

Examples of how to implement this action:

- Review and assess workloads; establish priorities and seek efficiencies
- Improve regulatory tools, including updating the legal and statutory foundation, modernizing technology and enforcement tools, and providing (cross) training
- Improve the ability for field staff to conduct education and outreach within their districts
- Enhance Department of Fish and Wildlife's capacity to work directly with water users and conservation interests

provide expertise on instream flow needs and can help prioritize streamflow restoration efforts, water use measurement projects, and voluntary initiatives or projects. ODFW staff can help determine potential impacts to fish, wildlife, and habitats from a proposed allocation of water and can recommend mitigation to offset the impacts.

## Strengthen Oregon's Water Quantity and Water Quality Permitting Programs

Several natural resources agencies in Oregon are engaged in water-related permitting. Just like the field staff described above, permit reviewers frequently answer calls or questions from water users, realtors, and others, conduct records research, and process case files. It is imperative that agencies have sufficient numbers of well-trained permitting staff in place to process requests in a timely, accurate manner.

### Water Right Permits

The Water Resources Department's Water Right Services Division administers several water right programs. Staff are responsible for processing water use permits, limited licenses, temporary drought permits, permit amendments, extensions, transfers (temporary and permanent), instream leases, conserved water projects, hydroelectric permits, reclaimed water use registrations, and more. The Department is also responsible for overseeing water management and conservation planning efforts of local entities and completing adjudication proceedings.

Once the Department determines that a new water use can be allowed, a permit is issued. The complexity of water-use applications has increased in the last twenty years; 80 percent of applications for new uses are for groundwater, which requires a thorough technical review. Water right permits, as well as newly-approved transfers, often include various conditions on the use of water. Installation of fish protection devices, totalizing flow meters, staff gages, water-use reporting, and taking annual groundwater measurements are common conditions for water use permits. Staff must make sure that water rights are conditioned correctly and staff must clearly describe to the water user what the conditions mean.

For staff to be effective, improving and expanding staff training is critical. The Division uses multiple programs for preparing and reviewing permits, certificates, and transfer documents. Investments need to be made to update technologies, manuals, and procedures that continue to improve efficiency, application processing time, and consistency between sections of the Department.

### Water Right Certificates

A water right certificate is the final stage of the water right permitting process. A report, called a "claim of beneficial use," must be submitted to the Water Resources Department. This detailed report allows the Department to evaluate the extent of water use developed within the timeframe allowed and within the terms and conditions of the permit.

For years, the Department struggled to keep up with reviewing these claims and issuing subsequent certificates. In 2004, there were 6,400 claims in the queue awaiting certificates. Since 2004, the Department has received approximately 4,760 new claims. With added staff and redistribution of workload, pending claims have been reduced dramatically. As of November 2017, there were 1,186 claims awaiting review. If the number of staff remains unchanged, the number of pending claims will be near 260 by the end of the 2020 calendar year.

The Department should develop informative outreach materials and follow-up procedures for permits, transfers, or extension applications, clearly explaining the requirements, especially any measurement or reporting conditions, to the water user. Meeting the terms and conditions of a water use permit or transfer is needed in order to obtain a water right certificate. Early, up front customer service at permit-issuance will help water users avoid compliance issues later on. Outreach materials should use layman's terms or define any technical terms, making them user friendly.

## Water Right Transfers

Having a water right certificate opens the door to other tools, such as transfers, that allow water users to change where their authorized water is diverted from, where it is used, or what it is used for. There is growing interest in the use of water right transfers to move water around to support 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 earlier in this chapter, is an innovative conservation tool available as part of the water right transfer program.

**Figure 4-7: Water Use Applications Received by WRD**

| Year | Permits | Transfers |
|---|---|---|
| 2012 | 173 | 179 |
| 2013 | 229 | 192 |
| 2014 | 319 | 249 |
| 2015 | 325 | 276 |
| 2016 | 416 | 341 |

The backlog in processing water right transfers in 2004 was about 760 applications. As a result of a number of process improvements conducted since 2014, the backlog as of July 2017 has dropped to 364 applications.

## Developing a Mitigation Strategy for Oregon

Mitigation will need to be more a part of the solution for Oregon. In the coming years, the state should develop a mitigation strategy, along with a roadmap to help water users and others understand what is needed and required. Mitigation is required for new groundwater use in portions of the Deschutes Basin. The development of a mitigation strategy would be beneficial anywhere in the state where acquiring a new surface water or groundwater use permit is otherwise not possible.

A statewide framework could set forth the legal authorities and possibly basic parameters, while basin-specific rules could provide more specific mitigation details depending on whether concerns are based on water availability, interference with other uses, or other potential impacts.

## Working with Partner Agencies

In Oregon, reviewing water right permits is done in partnership with other state agencies. The Oregon Departments of Fish and Wildlife and Environmental Quality review new water use permit applications to ensure that the proposed use is not detrimental to the protection or recovery of a threatened, endangered, or sensitive species and the use is consistent with existing water quality standards. In some cases, a new permit application can only be approved if it is conditioned in certain ways or mitigation is provided.

The Department of Fish and Wildlife's water program consists of just a few staff members, but frequently they are called upon to answer questions from their field staff, other agencies, and water users on proposed projects. The agency needs greater capacity to interact with the Water Resources Department, water right applicants, and field biologists. This would increase the understanding of water right review recommendations, including impacts to fish and wildlife, recommended mitigation obligations, and passage and screening requirements. Doing so would help facilitate a transparent, consistent, and stream-lined application process.

## Water Quality Permits

The 2015 Oregon Legislature directed the Oregon Department of Environmental Quality to hire an outside consultant to evaluate its National Pollutant Discharge Elimination System (NPDES) Water Quality permitting program and make recommendations to improve the quality and timeliness of individual NPDES permits. There are currently 360 individual municipal and industrial NPDES wastewater permits in Oregon, which must be renewed every five years. DEQ administers other water quality permits (general NPDES permits, Water Pollution Control Facility Permits, and water quality certifications), but the permit backlog that motivated this evaluation was concentrated in the individual NPDES permit program.

The consultants' work culminated in December 2016 with recommendations and an implementation plan.[15] The full report is available online. Through research and interviews with dozens of knowledgeable staff and stakeholders, the consultants identified a number of issues contributing to the NPDES permit backlog, including:

- Lack of clarity regarding decision-making responsibility
- Ambiguity regarding the roles of staff working on permits (technical advisor vs. regulator)
- Lack of coordination between water quality planning and permitting
- The difficulty for some dischargers to meet water quality standards, requiring complex regulatory solutions and/or expensive engineering

The consultants made numerous recommendations in the areas of leadership, community capacity, alignment across programs and with federal regulations, quality and efficiency, staffing and workload, program funding, and communications and progress reporting.

The overarching message in the consultant report is that eliminating the NPDES permit backlog and achieving a sustainable permitting program is dependent on addressing the recommendations in all topic areas, not all of which are fully under DEQ's control. The agency's fluctuating budget and multiple priorities, third party legal action, and the local capacity for planning, financing, implementing and operating treatment plant upgrades all represent significant barriers. If recommendations are only partially implemented, some gains may accrue, but a sustainable permitting program will not be possible.

DEQ and the Oregon Environmental Quality Commission are committed to implementing the recommendations in the report, and consider this to be a top priority for the agency – one that will likely require years of focused attention to resolve. Internal process improvements are underway and DEQ is engaging external partners and stakeholders to seek their assistance in implementing the report's recommendations.

The Water Quality program's immediate priorities include developing a longer-term work plan and a communications plan, implementing initial internal organizational changes, and undertaking a "permit readiness review." The readiness review identifies backlogged permits for which there are sufficient water quality data, compliance solutions, and community capacity to immediately proceed with permit renewal.

**Recommended Action 10.G**
**Strengthen Oregon's Water Quantity & Water Quality Permitting Programs**

Examples of how to implement this action:

- Expand staff training opportunities; provide adequate staffing
- Update technologies, processing manuals, and guidance documents
- Develop outreach materials and follow-up procedures to help water users understand the application process and permit, transfer, or extension requirements
- Develop a mitigation strategy
- Create stronger linkages among partner agencies
- Develop and implement a workplan to improve the quality and timeliness of individual National Pollutant Discharge Elimination System permits

The program will continue writing NPDES permits while implementing the recommendations, but during the initial stages, permit writers may be called upon to lend their expertise to critical process improvement efforts and updating permit writing tools and templates.  DEQ plans to provide more information on next steps and expected outcomes during the 2017-19 biennium.

# Critical Issue – Healthy Ecosystems

Responsibility for managing, protecting, and restoring Oregon's ecosystems falls across a broad range of local, state, federal, and tribal agencies, as well as on private landowners and local organizations.  Oregon has a rich history of work in this area, using numerous tools and institutions to help address and improve ecological conditions.  Chapter 2 described the status of Oregon's ecosystems, but focused recommendations around measurement and monitoring efforts.  By comparison, this section contains recommended actions related to ecosystem policies, programs, and projects.

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.  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 or access the floodplain;
- 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.

## Improve Watershed Health, Resiliency, and Capacity for Natural Storage

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.  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.

This section describes the important role that freshwater ecosystems play in Oregon and makes several recommendations for further improvements.

### Riparian Areas

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.

The state 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[16] and Oregon's Agriculture Water Quality Management Plans.[17] The state currently provides incentives for voluntary participation in these restoration-type projects, including funding and technical assistance. The Oregon Department of Fish and Wildlife, for example, administers a Riparian Incentive Program. One helpful research project for academics or agencies would be to identify and compare the list of state and federal incentives or funds available for riparian restoration.

## Wetlands and Floodplains

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 are also diverse habitats 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.

Oregon has lost about 40 percent of its original wetlands. The U.S. Fish and Wildlife Service estimates that Oregon has 1.4 million acres of wetlands today, compared to about 2.3 million acres of tidal and non-tidal wetlands that covered the same area in the late 1700s.[18] 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 disconnect in the valley's hydrologic regime has changed the character of the valley's wetlands and greatly altered their functions.

Developing a statewide floodplain policy could help establish a framework for regulation and permitting of floodplain restoration. Oregon should support ways to restore floodplain function, including implementation of actions described in Oregon's Conservation Strategy. This includes 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.[19]

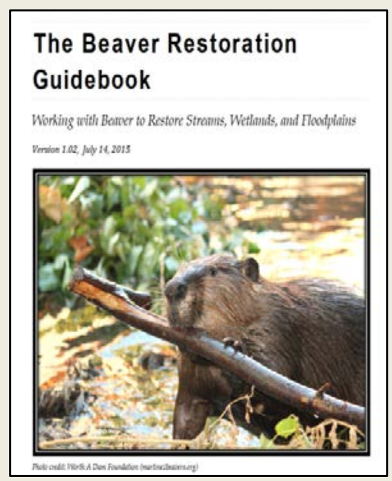
Through their ability to hold and slowly release water, filter and biologically process nutrients, and provide shade and habitat, upland wet meadows, riparian wetlands, and floodplain habitats directly affect water storage, hydrology, water quality, water temperature and habitat quality. The U.S. Fish and Wildlife Service notes, for example, the Klamath Refuges shallow marshes, open water, and grassy uplands support one of the most biologically productive refuges within the Pacific Flyway. Approximately 80 percent of the flyway's migrating waterfowl pass through the Klamath Basin on both spring and fall migrations.[21]

**Figure 4-8: Beaver Dams**

Salmon recovery plans recently developed along the Oregon Coast have identified beaver habitat as important for improving ecosystem function. Beaver dams support the creation of Coho salmon rearing habitat by impounding water and retaining sediment, and generally facilitating the changes in river channels that can result in increased stream meanders, pool formation, and reconnected and expanded floodplains. Beaver dams also act to raise the water table in alluvial aquifers, thus helping to increase summer streamflows, reduce stream temperatures, and expand riparian areas and wetlands.

The U.S. Fish and Wildlife Service developed a Beaver Restoration Guidebook in July 2015 to help those working with beaver to restore streams, wetlands and floodplains.[18]

While beavers can threaten man-made infrastructure because of their burrowing and blocking tendencies, beavers and beaver dams can play an important role in maintaining the health of our natural systems.



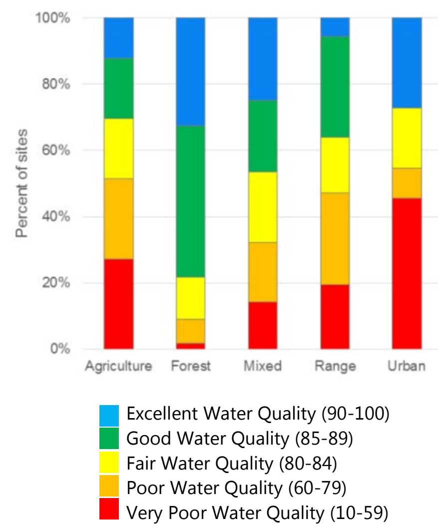

The Oregon Department of Fish and Wildlife has developed a clear set of guidelines to direct relocation efforts for beaver to carefully balance the potential for beaver to benefit fish and wildlife with possible damage issues.

## 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. Although most estuaries along the coast are relatively small, the Columbia River estuary at Astoria is the largest in area at more than 80,000 acres. 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. Managers along the West Coast are concerned about how sea-level rise and ocean acidification will alter estuaries and threatened species;[22] some communities are restoring tidal inundation to estuarine lands to build resiliency for coastal sea level change and tidal flooding.

**Figure 4-9: Influences of Land Use**
(from 2017 DEQ Oregon Water Quality Index)




## 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, store atmospheric carbon, and support Oregon's economy. Healthy forests promote soils that provide natural filtration to keep streams clean and water quality high.

Most of Oregon's municipal water systems rely on water that originates from forestlands, including those managed for wood production. At the state scale, data collected from DEQ's ambient monitoring network between 2007 and 2016 indicates that forestlands have the highest percentage of excellent or good water quality sites, compared to agriculture, urban areas, rangelands, and mixed land uses (see Figure 4-9).

Forests are part of the essence of Oregon, and our waters benefit from their sound management. However, 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 at risk of 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.

Forest diversity can offer a range of benefits when land managers incorporate multiple values—wood production,

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

Examples of how to implement this action:

- Improve riparian conditions to protect a healthy buffer between aquatic and terrestrial ecosystems
- Restore wetlands and floodplains to maintain critical functions like processing nutrients, providing habitat and storing water
- Protect estuarine conditions to maintain a healthy buffer between freshwater and marine systems
- Protect upland and forested areas, in part to maintain to source water quality
- Establish methods for measuring ecosystem services and incorporate results into planning efforts

aesthetics, recreation, habitat, water quality, and clean air. Awareness is growing that keeping forests in productive forest use should be a primary goal. Keeping forests as forests, however, requires public support, investment, and resource protection policies that make continued forest ownership an economically viable alternative to conversion. The Forestry Program for Oregon emphasizes this, and agencies should continue supporting efforts to maintain healthy, resilient, and functional forested areas, in part, for the benefit of water resources.[23]

## Develop Additional Instream Protections for Oregon's Rivers and Streams

In many areas of Oregon, streamflows are very low or even non-existent during late summer months. Low streamflow conditions may be further exacerbated by periods of intensive water use or drought. Low streamflows often mean higher water temperatures and increased nutrient concentrations, contributing to poorer water quality. Changes in the hydrologic regime, older culverts, and many 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.

### Scenic Waterways

The Oregon Parks and Recreation Department has the authority to recommend the designation of additional rivers or segments of rivers as scenic waterways. Oregon has one of the most extensive scenic waterway systems in the country, with more than 1,100 river miles protected for recreation, fish, and wildlife values. The designation of scenic waterways is a well-established tool that brings benefits to a local economy through recreation, while at the same time protecting natural values of the resource.

Oregon designated two new scenic waterways in January of 2016 – segments of the Chetco River in Curry County and the Molalla River in Clackamas County. These designations are now managed as part of the state's scenic waterway system and represent the newest additions to the program in more than twenty-five years.

These rivers were chosen because they meet the Scenic Waterways Act criteria for outstanding scenic, fish, wildlife, geological, botanical, historic, archeologic, and outdoor recreation opportunities. The Oregon Parks and Recreation Department utilized studies and citizen advisory groups to develop recommendations for designations and draft management plans for the two proposed waterways.[24] The Water Resources Department used the same advisory groups to develop scenic waterway flow requirements for the proposed reaches.

Additional designations are under consideration by the Oregon Parks and Recreation Department and its partners.

### Outstanding Resource Waters

Oregon's Environmental Quality Commission (EQC) has the ability to protect high quality waters that constitute an outstanding state resource, due to their extraordinary water quality or ecological values, or where special protection is needed to maintain critical habitat areas. In July 2017, the EQC designated the North Fork of the Smith River and its tributaries as "Outstanding Resource Waters," the first designation of its kind in Oregon or the Pacific Northwest.

Outstanding values of the North Fork Smith River include their exceptional clarity and color, valuable habitat for endangered populations of Coho salmon, several rare wetland plant species, and unique recreational opportunities, particularly for whitewater rafting and kayaking. The decision adds protections under Oregon's water quality standards to ensure that there is no degradation of water quality in these waters. The policies would prohibit new permitted point source discharges to the waters and would prohibit other activities that could degrade the current high water quality, exceptional ecological characteristics, and other outstanding values of the waters.

## Instream Water Rights

Oregon is working to establish additional instream water rights, where needed, to protect base flows, and continue to work on resolving protested instream water right applications. The Oregon Department of Fish and Wildlife's policy is to apply for instream water rights on waterways of the state to conserve, maintain and enhance aquatic and fish life, wildlife, and habitat, to protect and maintain water quality standards, and to support public uses relating to recreation and scenic attraction. The long-term goal of this policy is to obtain an instream water right on every waterway exhibiting fish and wildlife values.

Three agencies—the Department of Environmental Quality, Department of Fish and Wildlife, and Parks and Recreation Department—may submit applications for instream water rights to the Water Resources Department (WRD).

The Department of Fish and Wildlife is currently utilizing existing information to recommend flows for future instream water right applications and is prioritizing future studies. Collection and processing of new data is time-consuming, taking two to three years to complete each stream reach. New instream flow studies will provide data for future instream water right applications.

About 900 instream water rights were filed by state agencies during the early 1990s. Another 500 or so minimum perennial streamflows were established by administrative rule in the 1960s through the early 1980s and later converted to instream water rights. Many instream water rights afford protection during the summer months, with watermasters regulating stream reaches for the benefit of these rights. Other instream water rights are relatively junior to other water users on the stream and will depend on voluntary partnerships with senior water right holders to be effective.

Instream rights are held in trust by the Water Resources Department and are supposed to be measured and monitored. About 200 instream water rights have stream gages in place that monitor river flows. These gages show that instream water rights are generally met during fall and winter high flows, but met less consistently during summer low flows.

## Instream Transfers and Leases

Water users with existing water rights can also transfer water instream to restore streamflows, using several tools and programs administered by the Water Resources Department. Water users can voluntarily transfer their out-of-stream use, such as irrigation for agricultural crops, to restore instream flows on a temporary or permanent basis. The water user has the option of transferring an entire water right instream, or a portion thereof. 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.

Oregon is a leader in flow restoration. As of 2016, there were 416 active instream leases, instream transfers, and conserved water projects in place. Streamflow restoration transactions have resulted in 1,634 cubic feet per second of water protected instream for the benefit of fish, wildlife, recreation, and water quality.

**Recommended Action 11.B**
**Develop Additional Instream Protections**

Examples of how to implement this action:

- Designate Scenic Waterways where needed to protect recreation, fish, and wildlife uses
- Designate Outstanding Resource Waters where needed to protect extraordinary water quality or ecological values
- Establish additional instream water rights where needed to protect the full suite of flows for fish and wildlife, water quality, recreation, and scenic attraction
- Expand the use of voluntary programs to protect and restore streamflow, lake levels, and cold water refugia
- Expand the geographic range of flow restoration efforts by identifying flow restoration priorities

The majority of water put instream on a permanent basis through allocations of conserved water and instream transfers is senior water, with certificates pre-dating Oregon's 1909 water code.

Instream transfers and leases benefit greatly from active partnerships with Oregon's conservation organizations, including The Freshwater Trust, the Deschutes River Conservancy, and Trout Unlimited. Incentives offered by these organizations and others can help land 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. Developing and implementing strategies that identify and target watersheds with the highest instream flow needs helps to expand voluntary streamflow restoration beyond current efforts, on both public and private lands.

## Prevent 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 biologically 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.

Aquatic invasive species can flourish in waterways, choking out native plants that once grew there and clogging boat, hydropower, and irrigation infrastructure.

Quagga and zebra mussels, along with hydrilla (a waterweed), and Asian carp are among the top species of concern to keep out of Oregon. Quagga and zebra mussels and aquatic vegetation can be easily transported by trailered watercraft, and have spread rapidly in portions of the United States due to their adaptability, lack of natural predators and physical transport. Species like Eurasian watermilfoil and New Zealand mudsnails already contaminate some Oregon waterbodies.[25]

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 produce toxins or poisons that can cause serious illness or death in pets, livestock, wildlife, and humans. Some of Oregon's lakes and reservoirs experience annual outbreaks of blue-green algae.

Oregon's state agencies and partners should support the Aquatic Invasive Species Prevention Program and invasive species actions contained in the Department of Fish and Wildlife's 2016 Oregon Conservation Strategy. Key elements of the Strategy are to prevent new introductions of invasive species, control the scale and spread of infestations, and eradicate invasive species, if possible. This can be achieved by coordinating the efforts of public agencies and private citizens, including the use of boat inspection stations. Inspections act as a line of defense and

**Figure 4-10: Aquatic Invasive Species Prevention**

**ODFW performs a decontamination of quagga mussels at Ashland's watercraft inspection station.**

The Aquatic Invasive Species (AIS) Prevention Program was developed in 2009 with the passage of two bills by the Oregon Legislature. Through seven years of implementation, the AIS program has conducted more than 59,500 watercraft inspections which included 88 hot wash decontaminations for quagga/zebra mussels and more than 1,200 decontaminations for other types of aquatic invasive species.

The AIS Prevention Program is co-managed by the Oregon Department of Fish and Wildlife and Oregon State Marine Board. The primary objective is to keep Oregon's waters free of new aquatic invasive species.

an opportunity to educate the public about the risk of aquatic invasive species entering our state.

**Ballast Water –** The discharge of ballast water, used to provide stability for large commercial ships, is a primary pathway of concern for introducing non-indigenous species from foreign ports, potentially threatening our regional waterways.

DEQ was granted authority in 2002 to implement and enforce ballast water management regulations in an effort to reduce the risk of introducing new aquatic invasive species. State regulations prohibit the discharge of ballast water unless it meets specified management criteria that may include mid-ocean ballast water exchange or the use of shipboard treatment systems. Since 2012, the DEQ ballast water program has been supported by a 50-50 cost share between the General Fund and a fee on regulated vessels using Oregon waters. In addition to monitoring vessels for pre-arrival ballast management compliance, DEQ identifies high-risk arrivals and conducts vessel inspections and compliance verification sampling on at least 12 percent of vessels calling on Oregon ports.

**Recommended Action 11.C**
**Prevent and Eradicate Invasive Species**

Examples of how to implement this action:

- Support the Aquatic Invasive Species Prevention Program
- Support the Oregon Conservation Strategy's seven statewide actions to prevent new introductions, and decrease the scale and spread of infestations
- Continue to implement and enforce ballast water management regulations

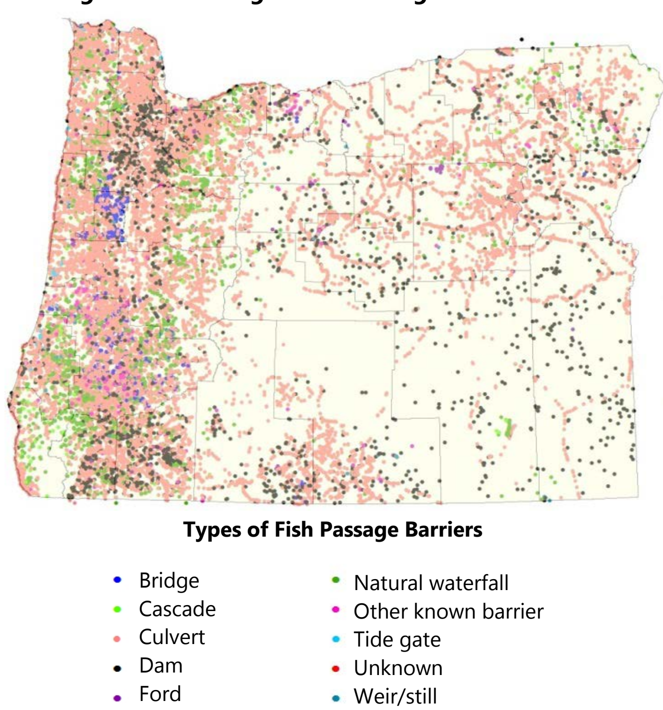
## Enhance Watershed Restoration and Fish Protections

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, instream habitat enhancement, and restoration of streamflows. All of these efforts have helped improve the ecological and economic health of Oregon's communities. Our 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 –** Barriers such as dams, dikes, road fill, and culverts change hydrological conditions and alter natural flow regimes. Many of these artificial obstructions create safety hazards for fish, can prevent fish passage altogether, alter transport of sediment and wood, and create an uneven distribution of habitat.

The 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. The Department of Fish and Wildlife has worked with several partners at the local, state and federal level to compile data on fish passage barriers throughout the state.

**Figure 4-11: Oregon Fish Passage Barrier Dataset**



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

This ongoing effort has resulted in the identification of almost 40,000 potential 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 potential barriers that were compiled are culverts. Some of the potential barriers identified are passable; others are partially blocking or completely blocking passage. For barriers located on private lands, it is difficult to determine whether they 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, tribal, and federal agency inventories still need to be incorporated into the compilation.

**Highlight Box**

**Investing in Habitat for Native Migratory Fish in Oregon**

Creating incentives to remove barriers to fish passage could go a long way to improving conditions for native migratory fish in Oregon. Working with staff from the Oregon Department of Fish and Wildlife (ODFW) and the Oregon Department of Transportation (ODOT), Willamette Partnership and The Nature Conservancy have built a package of tools to support a pilot fish passage mitigation banking program in Oregon's North Coast that could do just that.

Mitigation banking shifts how impacts are addressed from a case-by-case basis to pooling investment in projects that yield the highest ecological benefit. The amount of habitat affected by a project or created at a bank site is defined in terms of credits or debits – these units of fish habitat, both quality and quantity, are measured by a habitat quantification tool called the Net Benefit Analysis Tool.

As part of the pilot, ODOT has created Oregon's first fish passage mitigation bank – by removing a high priority barrier on the East Fork of the South Fork Trask River, opening up 23 miles of stream habitat for native migratory fish.

**An effective mitigation banking approach to fish passage should:**

- Provide greater net benefits for native migratory fish than providing passage at a waiver site;
- Streamline the waiver process for fish passage banking and make approval transparent and defensible; and
- Target and invest limited resources in reopening access to high quality habitat for native migratory fish.

In exchange, ODOT can waive the provision of fish passage on culvert repair projects in limited amounts of lower quality habitat, creating a net benefit for salmon and other fish species. At the end of the pilot phase (2015-2018), ODFW will be evaluating its success and lessons learned to potentially develop a statewide mitigation banking program for Oregon.

"ODOT considers this a promising way to more efficiently address fish passage for culvert infrastructure repairs and replacements. This process will allow ODOT to make vital culvert repairs and replacements while providing an increased net benefit to native migratory fish over the existing waiver (mitigation) process."

Find more information at: http://www.dfw.state.or.us/fish/passage/mitigation.asp

**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 Department of Fish and Wildlife operates the state's fish screening program and has helped install more than 1,500 fish screens through its cost-share program. Since the early 1990s, the state has required fish screening and/or bypass devices as a condition of approval for surface water permits and transfers.

The 2017 Legislature extended the sunset for fish screen tax credits through the end of 2023. 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 fish-friendly culverts, constructing fishways, stabilizing road fill material, and retiring obsolete and push-up dams are all techniques employed in Oregon today that 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 calls for specific measures to improve water quality and quantity and to address factors that contribute to declines in fish populations and watershed health. Many of these measures are voluntary and depend upon the willingness of private citizens to implement restoration projects. These voluntary measures continue to be fundamental to the success of the Oregon Plan.

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 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 Water Resources Department and the Department of Fish and Wildlife completed a joint project that identifies priority areas for streamflow restoration in basins throughout the state. These mapped areas represent watersheds in which there is a combination of need and opportunity for flow restoration to support fish recovery efforts. These maps should be updated to reflect new knowledge, such as species distribution and climate change information.

More recently, the Oregon Watershed Enhancement Board has created the Focused Investment Partnerships concept that provides funding to address issues of significance, such as aquatic habitat for native fish, Coho habitat along the Oregon coast, closed lakes basin wetlands, coastal estuaries, and more.

Along with the Oregon Watershed Enhancement Board, several state agencies, federal agencies and non-profit organizations provide financial assistance for these restoration projects. The U.S. Department of Agriculture's Natural Resources Conservation Service, U.S Bureau of Land Management, National Fish and Wildlife Foundation, the U.S. Environmental Protection Agency, the U.S. Forest Service, the U.S. Fish and Wildlife Service, NOAA Fisheries, and the Oregon Departments of Fish and Wildlife and Environmental Quality 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.

### The Oregon Conservation Strategy

The Oregon Conservation Strategy, touched upon earlier in the invasive species discussion, was developed in 2006 and updated in 2016. 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, while recognizing that conservation issues vary by region and must be tailored to the unique needs of the fish, wildlife and human communities that coexist. The Oregon Conservation Strategy engages citizens in monitoring key species and attributes of ecosystems, and encourages measuring the effectiveness of conservation actions.

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

Examples of how to implement this action:

- Continue to update the inventory of fish passage barriers
- Remove fish passage barriers and support fish screening efforts
- Build upon existing ecological planning and restoration efforts
- Update streamflow restoration priority areas using new species distribution and climate change information

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.

## Develop Additional Groundwater Protections

Groundwater flow contributes to springs, wetlands, and streamflow throughout the state. Contributions from groundwater support ecosystems and human systems alike. Just as this Strategy calls for the development of additional instream protections, this 2017 update also calls for the development of additional groundwater protections. Such protections benefit groundwater dependent ecosystems as well as senior water rights.

The Groundwater Act of 1955 (ORS 537.505 to 537.795 and ORS 537.992) established the authority for groundwater management and monitoring statewide for the preservation of the public welfare, safety, and health. The Legislative Assembly recognized, declared, and found that the right to reasonable control of all water within the state from all sources of water supply belongs to the public. The Act directs the state to determine rights to the use of public groundwater and to manage groundwater in conjunction with surface water within the prior appropriation system, recognizing the hydraulic connection between the two water sources. Two examples: ORS 537.769 notes that groundwater protection is a matter of statewide concern; ORS 537.775 says that wells shall be constructed and operated so they do not unduly interfere with other wells or surface water.

The Groundwater Act also directs the state to determine the extent, capacity, quality, and other characteristics of its groundwater bodies, which are used to inform resource management decisions. Other important aspects of the state's groundwater management policy provide that rights to use groundwater be protected, reasonably stable groundwater levels be determined and maintained, and groundwater overdraft be prevented.

The protection of groundwater quality is also a value set forth in Oregon's water quality statutes in ORS 468B.155, "The Legislative Assembly declares that it is the goal of the people of the State of Oregon to prevent contamination of Oregon's groundwater resource while striving to conserve and restore this resource and to maintain the high quality of Oregon's groundwater resource for present and future uses." All groundwater in the state is a potential drinking water source and should be protected from untreated stormwater, pesticides, and other forms of contamination. This value is emphasized again in ORS 468B.160(6) and then again in ORS 468B.167, noting the importance of working with local partners on groundwater quality protection programs, such as wellhead protection. ORS 468B.175 and 180 lay out the rationale and process for declaring Areas of Groundwater Concern and Groundwater Management Areas. Finally, ORS 468B.190 calls for an ongoing groundwater monitoring and assessment program to evaluate the quality of the state's groundwater resources.

Potential sources of groundwater contamination have been mentioned throughout this document and include naturally occurring arsenic, nitrates, pesticides, chemicals and chemical spills, and coliform bacteria from improperly maintained septic systems.

In recent years, advances in technology have resulted in dramatically increased oil and gas production in many parts of country, and have raised public concerns around the practice of hydraulic fracturing (fracking) and the potential for groundwater contamination in drinking water. Hydraulic fracturing typically involves injecting water, sand, and chemicals under high pressure into a bedrock formation via a well.

For drilling operations that propose hydraulic fracturing, the Oregon Department of Geology and Mineral Industries, Oregon Department of Environmental Quality, and other natural resource agencies work together to ensure that regulatory requirements are met. Currently, Oregon has one producing gas field located in northwest Oregon. However, hydraulic fracturing has not been utilized at this production facility.[26]

Agencies will need to continue ensuring that adequate protections are in place to prevent groundwater contamination.

### Groundwater Policy Set Forth in Rule

In addition to the protections set forth in statute, the Water Resources Commission and Environmental Quality Commission have adopted numerous administrative rules to further guide agency responsibilities and functions related to groundwater management. Oregon Administrative Rule (OAR) 690-200-0005 notes that the Water Resources Commission has established a series of rules to protect groundwater. Some of these Chapter 690 rules include:

- Division 009 – Groundwater Interference with Surface Water
- Division 010 – Appropriation and Use of Groundwater / Critical Groundwater Areas
- Division 190 – Exempt Groundwater Use Recording Requirements
- Division 200 – Water Supply Well Construction Standards
- Division 205 – Water Supply Well Construction Standards / Licensing
- Division 210 – Well Construction Standards
- Division 215 – Maintenance, Repair and Deepening of Water Supply Wells
- Division 220 – Abandonment of Water Supply Wells
- Division 230 – Geothermal Production and Injection Well Standards
- Division 240 – Monitoring Wells, Geotechnical Holes, and Other Holes
- Division 310 – Water Right Application Processing; Groundwater Applications
- Division 410 – Statewide Water Resource Management

The Environmental Quality Commission has established rules under OAR 340-040-0020, confirming that its anti-degradation policy is intended to prevent groundwater pollution and to control waste discharges to groundwater. Some of the Chapter 340 rules include:

- Division 040 – Groundwater Quality Protection
- Division 044 – Construction and Use of Waste Disposal Wells...(Underground Injection Control)
- Division 045 – Regulations Pertaining to National Pollutant Discharge Elimination System and Water Pollution Control Facility Permits
- Division 050 – Land Application of Domestic Wastewater...Biosolids...Domestic Septage

- Division 051 – Confined Animal Feeding or Holding Operations
- Division 053 – Graywater Reuse and Disposal Systems
- Division 071 – Onsite Wastewater Treatment Systems
- Division 073 – Construction Standards
- Division 122 – Solid Waste Orphan Site Account
- Division 150 – Underground Storage Tank Rules

### Calls for a Groundwater Workplan

The health and future of Oregon's groundwater resources were featured in several important venues during 2016-17, including discussions of the Water Resources Commission, media articles, a Secretary of State audit, testimony before legislative committees, and discussions of the Integrated Water Resources Strategy Policy Advisory Group. The Water Resources Commission and Policy Advisory Group have both called for a long-term plan for sustainable groundwater management.

**Priority Issue Areas –** Looking at the 2012 Strategy and the Water Resources Department's *2016 Monitoring Strategy*, there are eight primary groundwater issues that require more work and attention in a workplan. They are as follows:

- Improve groundwater data collection, analysis, and sharing (Recommended Actions 1.B, 1.C, 2.B, 5.A)
- Conduct additional groundwater investigations (Recommended Action 1.A)
- Assess and adjust groundwater administrative areas (Recommended Action 1.A)
- Invest in updated scientific modeling tools (Recommended Action 1.C)
- Protect groundwater through proper well construction (Recommended Action 7.A, 12.A)
- Improve protection of groundwater during the permitting and regulatory process (Recommended Actions 10.F, 10.G)
- Develop a groundwater mitigation program (Recommended Action 10.G)
- Assist communities with groundwater storage projects (Recommended Actions 10.B, 13.D)

**Workplan Components –** An implementable workplan will need to be developed with the participation of agency staff, Commissioners, partners, and stakeholders. It should include the following elements: why the task is important, the anticipated implementation process, timelines, resource needs, and challenges/policy issues. Proposed milestones will of course be contingent upon budget and other workload needs.

The workplan should spell out what tasks can be undertaken given current resources, and which would require additional resources. It should also note where additional authorities or policy support is needed in statute and which tasks may require additional rule-making.

**Recommended Action 11.E**
**Develop Additional Groundwater Protections**

Examples of how to implement this action:

- Develop a long-term plan for sustainable groundwater management
- Develop clear objectives and metrics
- Identify and prioritize important tasks
- Sketch out the necessary timelines, staffing, and resource needs

# Critical Issue – Public Health and Water

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 resources 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 as 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 issues advisories when it is unsafe for recreational water activities at beaches and lakes, or when fish and shellfish consumed from various waters should be limited. These agencies work with several other state, federal, and municipal agencies to keep the public informed.

## Ensure Safe 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 days or weeks. Prolonged exposure of chemical contaminants, such as nitrate or arsenic, can cause cancer or organ damage. Drinking water is vulnerable to contamination from many potential threats. The federal 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 smallest public water systems. While the federal Safe Drinking Water Act regulates water systems serving at least 25 users or 15 connections, Oregon rules cover water systems serving at least 10 people or 4 connections. State resources to apply regulations to these systems are severely limited, leaving very small system users potentially exposed to contaminants in drinking water.

**Figure 4-12: Environmental Justice Tools and Resources**

The U.S. Environmental Protection Agency has developed an environmental justice (EJ) mapping and screening tool called EJSCREEN.[22] It is based on nationally consistent data and an approach that combines environmental and demographic indicators in maps and reports. This screening tool highlights places that may have higher environmental burdens and vulnerable populations. EJSCREEN can also be used to support educational programs, grant writing, and community awareness efforts.

Oregon's nationally recognized Environmental Justice Task Force was created by the Legislature to help protect Oregonians from disproportionate environmental impacts on minority and low-income populations. The Task Force released a handbook of best practices on environmental justice.[23] Completed in January 2016, the handbook lays out tools and approaches that promote meaningful involvement and participation of all stakeholders in the development of state agency programs, actions, and decisions.

### Source Water Assessments

From 1998 to 2006, the Oregon Health Authority and Department of Environmental Quality conducted source water assessments, and are working on updated assessments now. Public water systems will receive these new assessments with more detailed information on the watershed or recharge area that supplies their well, spring, or intake (the "drinking water source area"). Public water systems and local communities can use the information to voluntarily develop and implement source water protection strategies.

The drinking water source area for most communities lies partially, if not entirely, outside of their jurisdiction and may include several different governing agencies as well as a diverse mix of landowners, businesses, and residents. With that in mind, the updated assessments include details characterizing the source area and potential risks that will allow water systems to involve potentially affected stakeholders early when developing protection strategies.

**Find Data on Public Water Systems**

https://yourwater.oregon.gov/

Oregon Health Authority Drinking Water Services maintains an online searchable platform to display data on public water systems in Oregon. You can find data such as coliform and chemical test results, violations, enforcements, public notices, and basic system information, such as sources used, treatment applied, and contact information.

Updated assessments will also provide key information that will allow communities to focus limited resources on higher risks within their drinking water source area. The information can be supplemented with local water system and community knowledge that can serve as a collaborative effort to address local water quantity and water quality challenges. The delineation of sensitive areas and identification of potential contaminant sources can be further refined through additional research, local input, and coordination with state agencies.

### Source Water Protection [new sub-title]

Source water assessments can be used for planning purposes and development of source water protection strategies. Examples include:

- **Natural Resources Planning.** Groundwater systems that serve greater than 10,000 people or more 3,000 service connections can voluntarily have their drinking water source area certified by Oregon Health Authority. Once certified, the source area is considered a significant resource under the Department of Land Conservation and Development's Land Use Planning Goal 5. The Goal 5 planning process can be used by cities and counties to plan and zone land to conserve identified Goal 5 resources.
- **Contingency Plans.** Water systems can use the information regarding potential source water risks to enhance contingency plans. Contingency plans contain procedures to be followed should threats such as chemical spills or natural disasters occur. Guidance for preparing a contingency plan and examples are available from the Oregon Health Authority.
- **Water Development.** Information can be used to explore the development of additional drinking water sources, providing data that can help identify lower-risk well, spring, or intake locations and to identify surrounding areas that should be protected now so they provide quality drinking water in the future.

The Regional Water Providers Consortium, for example, has long been active in source water protection efforts, having prepared its first source water protection strategy back in 1998.[29] Consortium members rely primarily on the Bull Run Watershed, one of the most protected water supply watersheds in the nation, and the pollution control strategy relies heavily on prevention.[30] In the late 1990s, the Consortium, along with other drinking water providers, helped develop and support the state's pesticide use reporting system through several legislative sessions. The reporting system was administered by the Oregon Department of Agriculture but has not been funded since the 2007-09 biennium. The reporting system contains quite a bit of data but to become fully functional again, would need funding and a new database structure.

Detailed information about developing source water protection strategies can be found on the Drinking Water Protection Program website.[31] The website also includes methods and results, sample drinking water protection plans, information for schools, and links to many other useful sites.

### Contaminants of Emerging Concern

Some chemicals that previously had not been detected are now being found at very low levels because of improved testing methods. 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 the occurrence and concentration of contaminants, which can be used in studies to determine if or how such contaminants pose individual, cumulative, or synergistic health risks to the public. These data could be used in conjunction with the U.S. Environmental Protection Agency's Unregulated Contaminant Monitoring Rule data to evaluate connections among source sensitivity, potential contaminant sources in the area, and overall system vulnerability to contamination.

### 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 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 and 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.

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.

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

Examples of how to implement this action:

- Assist drinking water systems of all sizes; increase resources for small water systems (less than 15 connections)
- Protect drinking water sources
- Increase understanding of occurrence and health implications of contaminants of emerging concern
- Encourage water providers to join the Oregon Water/Wastewater Agency Response Network
- Increase domestic well testing and provide updated support materials and education

The Oregon Health Authority's Environmental Public Health Program launched a "Domestic Well Safety Program," developing a new website for well owners, providing information about water quality testing, treatment, maintenance, and other resources. In 2015, the Water Resources Department partnered with Oregon Health Authority to develop and distribute a Water Well Owners Handbook for rural homeowners.[32]

More domestic well testing is needed, along with resources to help educate and train homeowners on water quality testing of private wells, proper well installation and maintenance, and wellhead protection (see also Recommended Action 8.C, Promote Community Education and Training Opportunities).

## Reduce Toxics and Other Pollutants

Protecting Oregonians from the impacts of toxic pollutants is one of the top priorities for DEQ. Thousands of toxic chemicals are in products that individuals and businesses use daily. Old chemicals that may not be sold 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

DEQ is updating its toxics reduction strategy, a document that identifies reduction options for a range of priority toxic pollutants that affect air, land, and water quality. The updated strategy will focus on complementing and supporting the goals of existing core programs that address toxic chemicals and pollutants. To the extent practical, the updated strategy will place an emphasis on reducing toxic pollutants at the source, rather than managing them after they are generated.

Oregon DEQ's current Toxics Reduction Strategy, completed in 2012, emphasizes collaboration and partnerships with other agencies and organizations to reduce priority toxic chemicals in the environment and people.[33] In addition, Executive Order No. 12-05 ("Environmentally Friendly Purchasing and Product Design") provides additional support for DEQ's Toxics Reduction Strategy by focusing the work of other state agencies on reducing toxics.[34] Thus far, the Executive Order has resulted in low toxicity procurement guidelines for state agencies (and other public entities that join state price agreements), and became an official policy of the Department of Administrative Services.

In 2013, DEQ provided support to the Department of Administrative Services in developing and implementing low toxicity procurement specifications for a new janitorial supplies price agreement, in collaboration with the State of Washington. This price agreement represented an estimated $20 million in state and local government purchasing power. Similar safer chemistry product procurement efforts have been initiated for office supplies and furniture.

DEQ has also been collaborating closely with other states during the past five years, through the Interstate Chemicals Clearinghouse and other groups, to advance green chemistry and promote safer chemical alternatives to priority toxic chemicals that reduce environmental and health impacts while producing potential economic benefits.

Two other high priority short-term actions identified in the 2012 Toxics Reduction Strategy were to expand and enhance the Pesticide Stewardship Partnership program and ensure support for regular pesticide waste collection events to reduce non-point sources of toxic pollution in Oregon waters. These efforts are summarized in the following sections.

### Water Quality Pesticide Management Plan

An important task for managing pesticides is to implement the statewide Water Quality Pesticide Management Plan.[35] The Water Quality Pesticide Management Team, comprised of representatives from the Oregon Department of Agriculture, Department of Forestry, Department of Environmental Quality, Oregon Health Authority, Oregon Watershed Enhancement Board, 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 guidelines and reference points;
- Conduct 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, a voluntary, collaborative approach called the Pesticide Stewardship Partnership (PSP) program has been implemented to identify problems and improve water quality associated with current pesticide use at the local level. The state agencies comprising the Water Quality Pesticide Management Team work with Oregon State University Extension and the Integrated Plant Protection Center, soil and water conservation districts, watershed councils, grower groups, agricultural chemical distributors, and tribes to use monitoring data to drive focused voluntary actions in watersheds that reduce pesticide impacts on water quality. Prior to 2013, the PSPs were funded largely through federal grants and in-kind contributions from partners. The Oregon Legislature provided stable funding to the Department of Agriculture and Department of Environmental Quality for PSP implementation and expansion in 2013 and 2015. These funds support water monitoring, data analysis, project coordination, pesticide waste collection, and stewardship technical assistance grant projects. The Water Quality Pesticide Management Team helps guide these local partnerships and assists in the interpretation of the monitoring data.

Currently there are nine partnerships in eight watershed areas. Work is underway in Hood River; Mill Creek and Fifteenmile Creek (in Wasco County); the Walla Walla River; Clackamas River; Pudding River; Yamhill River (Yamhill PSP for rural and urban areas, and South Yamhill River PSP for forested areas of the watershed); the Amazon Creek watershed project in Eugene, and the Middle Rogue watershed near Medford. Pilot water monitoring has also occurred in the Middle Deschutes (near Madras), South Umpqua (near Roseburg), and South Coast (near Coos Bay and Bandon) watersheds.

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

**Highlight Box**

**Pesticide Stewardship Partnership in the Clackamas River Basin**

Partners in the Clackamas River Basin are targeting efforts to improve and protect water quality. Initiated in 2005, the Clackamas Basin Pesticide Stewardship Partnership (Clackamas PSP) is a voluntary, collaborative process to protect the river and its tributaries.

Local and state organizations offer water quality monitoring, resources and training for landowners and managers to enable more efficient and effective pesticide use that reduces drift and runoff. Pesticides in the Clackamas River watershed have many applications including residential lawns and gardens, business landscaping, public parks, road and ditch maintenance, nurseries, berries and vegetables, Christmas tree farms, forestry, and golf courses.

Partners created a windsock program where calibrated windsocks are provided to growers throughout Clackamas County. The windsocks attach to sprayers so that when an applicator reaches the end of a row they can see in real-time the approximate wind speed and direction. This allows growers to make better decisions when spraying and avoid pesticide drift.

The program is a partnership between the Clackamas Soil and Water Conservation District (SWCD) and the Clackamas River Water Providers, a coalition of municipal water providers that obtain drinking water from the Clackamas River.

Sprayer calibration and smart sprayer technology dramatically reduces off-target pesticide loss. Several partners, including Clackamas SWCD, OSU Extension, ODA's Integrated Plant Protection Center, and Clackamas River Water Providers have offered several calibration training events to local growers and producers.

The Clackamas PSP also utilizes state and/or local funds to hold agricultural pesticide collection events. Since 2009, the Partnership has collected and paid for proper destruction of 66 tons of old, restricted, or damaged pesticides. The Clackamas SWCD has partnered with the Clackamas River Water Providers on all events. Other event partners have included the Oregon Department of Environmental Quality, Oregon Department of Agriculture (ODA), Clackamas River Basin Council, and Clackamas County.

The Clackamas River Basin Council has done water quality monitoring to support the Clackamas Pesticide Stewardship Partnership. Several other partners do macroinvertebrate monitoring to evaluate water quality.

In the future, partners plan to continue promoting the use of beneficial insects to control agricultural pests and reduce pesticide use, along with encouraging erosion control practices such as field borders and cover crops to keep soil particles containing legacy pesticides out of surface water sources.

For more information: https://conservationdistrict.org/programs/pesticide-stewardship-partnership

## Hazardous Waste Collection – Pesticides and 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.

Pesticide waste collection events around Oregon provide an opportunity to bring unused and unusable pesticides from agricultural growers and other commercial and institutional pesticide users to a central location to properly dispose of them for free. These collection events help to remove old or unusable pesticides that pose a direct threat to Oregon's water quality. Since 2014, when regular collections began with stable funding from the Oregon Legislature, more than 209,000 pounds of pesticides have been collected at collection events from more than 350 commercial or institutional pesticide users. These events have now been incorporated into the state PSP program. Some state pesticide collection funds are also transferred to county and regional entities (representing Hood, Sherman, Wasco, Union, Baker and Wallowa Counties) that operate permanent hazardous waste collection facilities to support their periodic free agriculture pesticide collections for local growers and other pesticide users.

Like pesticides, unused medications can pose problems for Oregon's water resources. Often, unused or expired medications are disposed of by flushing down drains in homes, care facilities, medical clinics, doctors' offices, and hospitals. In a 1999 national study, scientists analyzed streams for 95 different organic wastewater contaminants, including pharmaceutical compounds.[36] One or more of these wastewater contaminants appeared in 80 percent of the streams. These results were mirrored in a 2014 report by U.S. Environmental Protection Agency Region 10, which summarized studies of water quality, sediment samples, and fish tissue, finding evidence of estrogen-like compounds, pharmaceuticals, personal care products, perfluorocarbons, and flame retardants throughout the Columbia River and its tributaries.[37] Risks posed to aquatic organisms by long-term exposure to various pharmaceutical compounds are unknown.

Wastewater treatment plants and septic systems, depending on the level of treatment, may only partially treat pharmaceuticals which would allow 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; and protects water quality and aquatic species.

Oregon should continue "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 have historic releases of hazardous substances that threaten water resources. The nature and degree of such threats depend on the types and amounts of contaminants, when they were released, the likelihood of migration to surface water or groundwater, and remedial actions completed, if any. Oregon's Leaking Underground Storage Tank program identifies and addresses hazardous or contaminated sites, and prioritizes investigative and remedial actions based on threats to human health and the environment – with a focus on protecting sensitive water resources. Site owners complete most work on a voluntary basis, with program oversight. However, as needed, the program uses enforcement mechanisms to eliminate or treat discharges to sensitive water resources. This includes use of DEQ's Orphan Site Account when site owners are unknown – or unable (and in some cases unwilling) – to perform immediate cleanups. For lower priority sites, it is important to continue providing technical and financial assistance to clean up existing contaminated sites that could in the future affect groundwater or surface water.

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.

In Oregon, brownfields have been cleaned up and turned into new businesses with new jobs; urban community gardens; mixed-use developments that include housing, retail, and commercial facilities; food bank operation centers; thrift stores; and health-care centers in a number of rural Oregon communities.  The economic and community development opportunities are many for brownfields, and DEQ takes this effort seriously, in order to prevent future exposure to contamination and ensure that environmental justice and community health concerns are integrated throughout redevelopment and reuse planning. Therefore, Oregon will 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 fish and shellfish accumulate toxic chemicals because of legacy contamination, spills, or toxic algal blooms, they can pose health risks to those who consume them.  DEQ 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 worked with tribes, agency partners, and other stakeholders to revise the fish consumption rate and Oregon's water quality standards.  These standards, approved by U.S. Environmental Protection Agency in 2011, 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 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 beaches, rivers, lakes, and other water bodies.

Issuing fish and shellfish consumption advisories is one such tool used by agencies.  The Oregon Health Authority issues fish consumption advisories, due primarily to moderate-to-high mercury levels or PCBs (polychlorinated biphenyls) found in locally caught fish.  As of April 2017, there were 19 specific water bodies where fish consumption advisories existed.  In 2016, a statewide advisory was issued for mercury in bass.

In 2015, the Oregon Health Authority worked with DEQ and the Department of Agriculture to issue a coastwide advisory limiting the consumption of softshell clams (*Mya arenaria*) and gaper clams (*Tresus capax*), due to elevated levels of inorganic arsenic.

The Departments of Agriculture and 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 algal 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 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.

**Harmful Algal Bloom Advisories –** Public health and safety concerns associated with recreational use of lakes and other waters have been growing over the past several years.   Blue-green algae, or cyanobacteria, can irritate skin, cause liver damage, or affect the nervous system and thrives in warm, stagnant waters that have significant concentrations of nutrients, particularly phosphorus.  An overgrowth of algae in the water can result in the development of a harmful algal bloom (HABs), which can produce extremely dangerous toxins that can sicken or kill people and animals.

The U.S. Environmental Protection Agency notes that HABs are a major environmental problem in all 50 states. In Oregon, algal bloom advisories are only issued for lakes, reservoirs, and rivers where a lab has verified the presence and quantity of a harmful algae species or the toxins they produce. Only a fraction of Oregon's many water bodies are monitored for HABs due to limited staff and monetary resources.

The Oregon Health Authority is the agency responsible for posting warnings and educating the public about algal blooms. Once a waterbody is identified as having HABs, DEQ is responsible for investigating the causes, identifying sources of pollution and writing a pollution reduction plan. DEQ developed a Harmful Algal Bloom Strategy in 2011 to describe and recommend improvements to an overall strategy that the Department can implement in order to prevent and control, where possible, HABs in Oregon.[38]

Recommendations include seeking resources to improve the capacity to coordinate agency responses to address public health concerns and enhancing DEQ's focus on identifying and addressing the specific causes of waterbodies impaired by HABs.

Along with better coordination and monitoring, key preventative actions include reducing the formation of blue-green algae in lakes, streams and ponds beyond natural background levels. 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 federal 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 provides funding to monitor the coast and recreational shellfish for cyanobacteria, given the federal budget environment, these and similar programs are at risk of being eliminated.

**Recommended Action 12.B**
**Reduce the Use of and Exposure to Toxics and Other Pollutants**

Examples of how to implement this action:

- Update and implement the Department of Environmental Quality's 2012 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
- Continue "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 2016, Oregon adopted the U.S. Environmental Protection Agency's 2012 Recreational Water Quality Criteria, revising bacteria standards in freshwater and estuaries, and lowering the Beach Action Value that is used to trigger public notification programs.[39] If the Oregon Beach Monitoring Program were able to sustain current monitoring efforts, the revised standards would likely result in double the number of beach advisories. However, it is more likely that Oregon will experience both a decline in the frequency of monitoring activities/number of monitored locations and some increase in the number of beach advisories.

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.

## Implement Water Quality Pollution Control Plans

The long history of assessing and reporting on the conditions of Oregon's waters began in 1938 when the Oregon State Sanitary Authority (now the Oregon Department of Environmental Quality) was established as a result of a citizen initiative.

Today, the 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.

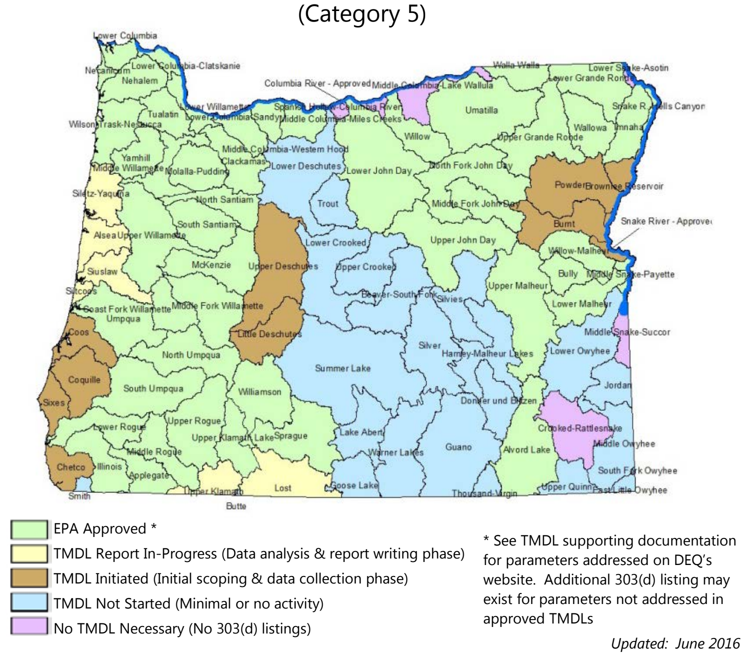
It is important to continue developing and implementing TMDL plans for water bodies that do not meet water quality standards. This includes developing TMDLs for remaining water bodies and pollutants on Oregon's 303(d) impaired waters list and for those added in the future, in accordance with the federal Clean Water Act. It also includes reviewing and updating existing TMDLs and providing oversight to ensure that TMDL implementation measures are effective. By the end of 2016, the Department of Environmental Quality had completed 1,153 TMDLs (see Figure 4-13).

### Nonpoint Sources of Pollution

A nonpoint source (NPS) of pollution is any pollution entering a waterbody that does not come directly from a pipe. Unlike end-of-pipe pollution that originates from industrial and sewage treatment plants, NPS comes from many diffuse sources, including runoff from agricultural, forest and ranching activities, construction sites, home landscaping, and road surfaces.

Oregon's Nonpoint Source Pollution Program is an important part of the state's water pollution control programs because for some pollutants, nonpoint sources are a major contributor of pollution to a waterbody. The Program's strategy involves using water quality management programs in conjunction with regulatory, voluntary, financial and technical assistance. The program's primary components are assessment, planning, implementation, and education.

**Figure 4-13: TMDL Development Status for 303(d) Listed Waters**
(Category 5)



The federal Clean Water Act provides states, territories, and tribal governments opportunities for funding, commonly referred to as Section 319 grants, for technical assistance, education, training, technology transfer, demonstration projects and monitoring to assess the success of specific nonpoint source implementation projects. In 2010, Oregon awarded more than $1.38 million in Section 319 grants to 33 projects to address nonpoint source pollution. In recent years, the amount of 319 funds Oregon receives from the U.S. Environmental Protection Agency has been reduced to less than a third of 2010 levels. Oregon should work with its Congressional Delegation to restore the level of funding to 2010 levels and implement nonpoint source pollution reduction projects.

There are also several Farm Bill conservation programs, administered through the Natural Resources Conservation Service, for agricultural producers and landowners. In recent years, Oregon ranchers have worked extensively with public and private sector partners to install and model effective habitat restoration techniques. These include fencing riparian areas and building stock water troughs to protect sensitive riparian areas from livestock.

Oregon will need to continue assisting landowners with the management of nonpoint source pollution across all land uses (e.g., urban, agriculture, forestry) to ensure the protection of surface water and groundwater. This should build upon the Forest Practices Act and the Agricultural Water Quality Management Act and area plans to ensure compliance with water quality standards and TMDL load allocations. Monitoring would help improve 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 permits are required for stormwater discharge that leaves the site through a "point source" and reaches surface waters either directly or through storm drainage.

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 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 the U.S. Environmental Protection Agency 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 MS4 permits, TMDL Implementation Plans for Urban Designated Management Agencies, best management practices, or through comparable voluntary plans.

### Septic Systems in Rural Areas

State law provides DEQ 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 the counties of Baker, Coos, Curry, Grant, Jackson, Josephine, Morrow, Union, Wallowa, and Wheeler. The 26 remaining counties manage the program through local governments under contract and oversight from the state.

In 2016, the Oregon Legislature provided seed funding for DEQ to award a grant to a third-party lender to establish a low-interest loan program for the repair or replacement of failing on-site septic systems. The primary objective was to create a financial assistance program for low and moderate income applicants facing expensive repairs or replacement, who are unable to obtain traditional financing.

In September 2016, DEQ awarded a $200,000 grant to the non-profit lender Craft3 to develop and implement the program. If successful, DEQ is hopeful that additional funding from public and private sources can be made available to make low-interest loans available to more Oregonians who need them.

**Recommended Action 12.C**
**Implement Water Quality Pollution Control Plans**

Examples of 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 and evaluate the effectiveness of pollution control plans
- Ensure effective management and oversight of stormwater in urbanized areas
- Assist communities with septic system challenges

# Critical Issue – Funding for Oregon’s Water

This section lays out funding needs in five fundamental categories discussed throughout this document: funding Oregon’s Integrated Water Resources Strategy, water resources management at state agencies, and assisting with local water challenges by funding planning, feasibility studies, and implementation efforts.

## Fund Oregon’s Integrated Water Resources Strategy

During 2015-17, the Water Resources Department had one full-time coordinator developing the 2017 Integrated Water Resources Strategy. The Departments of Agriculture and Fish and Wildlife each had one staff member as well; the Department of Environmental Quality had three.

The state is required to update the Strategy every five years. This allows us 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.

Meaningful strategy involves public interaction, regular meetings of the Policy Advisory Group, Agency Advisory Group, and Federal Liaison Group, briefings of boards and commissions, and countless hours tracking down the status of Oregon’s water-related policies, programs, and practices.

The goals, objectives, and recommended actions spelled out in the Integrated Water Resources Strategy require dedicated funding for implementation and coordination among state, local, federal, and private partners.

**Recommended Action 13.A**
**Fund Development and Implementation of Oregon’s Integrated Water Resources Strategy**

Examples of how to implement this action:

- Fund implementation of the 2017 Integrated Water Resources Strategy
- Fund the five-year required updates, next one scheduled for 2022

## Fund Water Resources Management at State Agencies

Although some of the recommended actions in this document fall under the purview of the private sector, nonprofit organizations, or academic institutions, the majority of recommended actions will fall to the public sector, particularly state agencies. The state plays a complex role when it comes to water resources management—supporting economic development while also protecting the public interest in areas like the environment, public health, and public safety.

The Integrated Water Resources Strategy sets forth recommended actions and provides examples of potential ways to implement these actions. For day-to-day operations at state agencies, there are myriad examples of implementation activities that require funding:

- Improving scientific information for surface water and groundwater, including data collection, analysis, sharing, and use in decision-making
- Overseeing measurement and reporting by water users
- Conducting economic studies and water demand forecasts—both instream and out-of-stream
- Updating technical tools, including software, apps, databases, maps, models, and education/outreach materials
- Updating plans for strategic measurement, place-based planning, hazard mitigation/resiliency, and river basins
- Understanding and protecting streamflows, lake levels, groundwater, wetlands, floodplains, and refugia
- Updating water quality standards and TMDLs
- Improving water research and expertise related to energy use, building codes, land use, climate change, extreme events, water-use efficiency and conservation, re-use, storage, and other water management issues
- Providing forecasting and evaluation tools with regard to climate change, drought, flood and earthquakes
- Strengthening our field presence to communicate with and to educate the public about water issues
- Conducting compliance, public health/safety monitoring and inspections; requiring necessary improvements
- Protecting and restoring instream habitat and access, including fish passage and fish screening
- Studying and designating additional scenic waterways, outstanding resource waters, and instream water rights
- Monitoring for and preventing invasive species, toxics, pollution, and hazards
- Coordinating and partnering with other public and private entities
- Evaluating program effectiveness
- Providing engineering, scientific, permitting, regulatory and other technical expertise to partners, stakeholders, and customers

### Sources of Agency Funds

The operating budgets of Oregon's natural resources agencies depend on a variety of funding sources, which can dictate the activities on which state agencies have time, staff, and resources to focus. Economic development activities, for instance, are often partially supported by fee revenues or contract funds. Environmental protection activities have often depended on federal funds, but federal funds have dwindled in recent years.

**The General Fund —** The General Fund is used for a variety of public purposes and the amount of General Fund is limited, meaning there is intense competition for these monies. The General Fund is also used to pay for education, human services, and public safety. In 2009-11, the General Fund investment in natural resources agencies equated to less than one percent, or $145 million, of the $13 billion General Fund budget. In the most recent budget (2017-19), that share has inched above one percent with $221 million of the $19.9 billion budget.

**Figure 4-14: General Fund Support for Natural Resources Agencies**

| | Legislatively Adopted Budget | | | |
|---|---|---|---|---|
| | 2011-13 | 2013-15 | 2015-17 | 2017-19 |
| Agriculture | 12.9 | 18.7 | 23.4 | 22.3 |
| Columbia River Gorge Commission | 0.8 | 0.9 | 0.9 | 1.0 |
| Health Authority - Drinking Water | 0.0 | 0.0 | 0.0 | 0.0 |
| Energy | 0.0 | 0.0 | 0.0 | 0.0 |
| Environmental Quality | 25.1 | 29.9 | 33.9 | 44.6 |
| Fish and Wildlife | 7.1 | 17.2 | 30.1 | 28.4 |
| Forestry | 47.9 | 54.4 | 63.4 | 68.2 |
| Geology & Mineral Industries | 2.5 | 2.5 | 4.1 | 4.6 |
| Land Conservation & Development | 10.9 | 12.3 | 13.2 | 13.0 |
| Land Use Board of Appeals | 1.3 | 1.5 | 1.8 | 1.9 |
| State Lands | 0.0 | 0.0 | 0.3 | 5.0 |
| State Marine Board | 0.0 | 0.0 | 0.0 | 0.0 |
| Parks & Recreation | 0.0 | 1.0 | 0.0 | 0.2 |
| Water Resources | 20.6 | 26.5 | 29.6 | 31.5 |
| Watershed Enhancement Board | 0.0 | 0.0 | 0.0 | 0.2 |
| **Total GF for Natural Resources:** | $129M | $165M | $201M | $221M |
| **Total GF Budget:** | $16.5B | $15.6B | $17.9B | $19.9B |
| **Percentage of Total:** | **0.95 %** | **1.06 %** | **1.12 %** | **1.11%** |

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 they decline with each economic recession.

Federal funding in general is expected to dwindle. This loss will be further amplified if state agencies no longer have the state funds to enter into cost-match arrangements with federal agencies; federal matching funds will be left on the table as well.

The state's core responsibilities related to water, described in detail throughout this document, are underfunded and have been for years. Adequate funding is needed in order to ensure Oregon's natural resource legacy for future generations and to implement our shared vision for the future.

**Alternatives to the General Fund —** Stakeholders in Oregon are developing a number of ideas to stabilize agency budgets. Oregon's Water Resources Commission appointed a subcommittee in August 2010 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

**Recommended Action 13.B**
**Fund Water Resources Management Activities at State Agencies**

Examples of 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

must be logistically reasonable.  The Governor requested a bill in 2013 that would have established an annual water right management fee.  The Oregon Legislature introduced a similar bill in 2017.  Neither one passed.

## Invest in Local or Regional Water-Planning Efforts

Planning is done successfully by ensuring that resources exist to help organize people and facilitate the conversation.  It also takes resources to gather existing information and to complete new technical assessments that fill key knowledge gaps.  In any planning effort, communication and outreach are fundamentally important and require investment of both time and resources.

In the coming years, an effective statewide Strategy will require planning efforts at the local level and regional level as well, such as place-based integrated water resources plans that can guide a series of actions and projects over time.  Funding should continue to 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.

Other planning efforts should be supported as well.  Water management and conservation plans, typically developed by larger public water suppliers, are planning tools that lay out steps to meet long-term water demands in the future.  These plans can be costly and often small water systems lack the technical or financial capacity to develop these on their own.  Providing funding to support development of municipal or agricultural water management and conservation plans could help those communities most in need.

Hazard mitigation planning is another tool to prepare for the next drought, flood, or other natural disaster.  State, tribal, and local governments engage in hazard mitigation planning to identify risks and vulnerabilities and long-term, broadly supported strategies.  A plan approved by the Federal Emergency Management Agency is required for receiving certain types of disaster assistance, including funding for mitigation projects.

Oregon's statewide hazard mitigation plan was approved in 2015 by the Federal Emergency Management Agency with enhanced status, making Oregon one of 12 states that can receive increased funds under the Hazard Mitigation Grant Program.[40]

Lastly, and separate from the examples noted above, it has been several decades since the state completed any sort of comprehensive revision to its basin plans.  These plans, known as basin programs, exist as a set of administrative rules that establish water management policies and objectives for use of water in each basin.  Some of the basin programs lack critical information, such as classifications for groundwater.  Over the years, the Water Resources Department has been able to update some of its rules with minor revisions, but a more comprehensive update would require planning-level support.

**Recommended Action 13.C**
**Invest in Local or Regional Water-Planning Efforts**

Examples of how to implement this action:

- Continue to authorize and fund public and private investments in efforts such as place-based integrated water resources planning
- Provide funding to assist small water systems to develop water management and conservation plans
- Provide funding to support hazard mitigation planning (e.g. droughts, floods) at the local level
- Support river basin-planning updates

**Highlight Box**

**Planning for Future Water Needs for Rivers, Farms, and Cities**

The Deschutes River runs north, covering roughly 250 miles, and has numerous tributaries and three sections: the Upper Deschutes, which begins at Little Lava Lake and runs down to Bend; the Middle Deschutes, which extends to Lake Billy Chinook; and the Lower Deschutes, which flows to the Columbia River. The Deschutes is a spring-fed river that is known for its consistent streamflow fed by groundwater captured by the Cascades Mountains.

Management of the river has altered the timing and volume of streamflows. In the winter, Upper Deschutes River flows are reduced to fill the reservoir for the following water supply season. Nearly 90 percent of the streamflow from the Deschutes River in Bend is diverted through irrigation canals, which causes a reduction in streamflow in the Middle Deschutes. The Deschutes River supports agricultural producers in seven irrigation districts growing a variety of crops, ESA-listed fish species and amphibians, some of the fastest growing cities in Oregon, and world-class recreational opportunities.

Local partners in the Deschutes Basin have been working together for more than twenty years to identify creative ways to meet the water needs of rivers, farms, and cities. Prior studies assessed available water and anticipated needs through 2050 and found an overall need of 230,000 acre-feet of unmet demand each year for agricultural, instream flow, and municipal needs.

Building upon these studies, partners have initiated a larger basin planning effort in the Upper Deschutes Basin. A workgroup was formed in 2015 to support the basin study. Using a collaborative, consensus-based process, nearly 40 local, state, federal, and tribal partners are contributing to the study. The Study is supported by the Bureau of Reclamation's WaterSMART program and funded by federal and state funding sources. Private foundations and local partners are contributing significantly to the planning efforts as well.

A key focus of the planning study is not only water supply and demand, but taking into account climate change and analyzing how existing operations and infrastructure will perform under projected future conditions. Partners will develop and evaluate options for addressing water imbalances, considering various factors such as cost, environmental impacts, risks, and other criteria. Once the study is completed, partners hope that it will provide a broadly-shared vision for future water management options in the basin.

Find more information at: https://www.usbr.gov/pn/studies/deschutes/index.html

## Invest in Feasibility Studies

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 resources projects, ranging from infrastructure finance, to feasibility study grants for water supply, conservation, and reuse projects, and grants for watershed protection and restoration activities.

Local communities find it most 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.D**
**Invest in Feasibility Studies for Water Resources Projects**

Examples of how to implement this action:

- Continue to provide Feasibility Study Grants to help evaluate the feasibility of water conservation, storage, and reuse projects
- Review and update the Feasibility Study Grants program based on lessons learned since 2008

One way Oregon can help with costs is to bridge the existing funding gap for feasibility studies. In 2008, the Water Resources Department initiated funding for Feasibility Study Grants, plus funds for the Umatilla Basin Aquifer Recovery Project. Since 2008, the Water Resources Department has provided approximately $4.8 million dollars of grant funding for 76 feasibility studies. These grant dollars have leveraged approximately $14.8 million dollars of matching funds and in-kind services, to determine the feasibility of water conservation, storage, and reuse projects.

Since the funding opportunity is nearly 10 years old, the state should conduct a programmatic review of the Feasibility Study Grant funding opportunity in order to understand and pursue program updates. In particular, the state should examine how this funding opportunity links to other funding opportunities for water projects.

## Invest in Project Implementation

In a 2016 survey of member cities, the League of Oregon Cities projected a need of $9 billion to address water and wastewater infrastructure needs over the next 20 years. 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, nor agricultural infrastructure investments that Oregon needs to undertake in the coming years.[41] The American Society of Civil Engineers (ASCE) has estimated similar costs. In its 2017 *Infrastructure Report Card for Oregon*, ASCE estimates Oregon's infrastructure need in the drinking water sector at about $5.6 billion and in the wastewater sector, about $3.89 billion, for a total of $9.49 billion.[42]

### Infrastructure Financing

There are several agencies and organizations in Oregon aimed at helping communities, districts, and businesses with the financial costs of water-related infrastructure. Business Oregon's Infrastructure Finance Authority 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 hundred million dollars have been awarded through these programs (see Figure 4-15). The Infrastructure Finance Authority just recently surpassed $300 million in water system funding to 173 projects across 31 Oregon counties through the Safe Drinking Water Revolving Loan Fund.

It also provides funds for technical assistance projects, such as developing or updating facility plans, water system master plans, engineering studies, preliminary or final designs for projects, and levee repair.

DEQ also administers a revolving loan fund, called the "Clean Water State Revolving Loan Fund," which provides low-interest loans to public entities for the planning, design, and construction of various projects that prevent or mitigate water pollution. This loan program typically provides $50 million annually for funding projects and has provided $1.2 billion in water improvement loans since 1990. Several projects are eligible for funding, including wastewater treatment facilities, irrigation improvements, stormwater facilities, brownfield projects, and water reuse projects, to name a few.

**Figure 4-15: Water and Wastewater Project Awards by Program (2007-2016)**

| Water Infrastructure | Wastewater Infrastructure | Water Tech. Assistance | Wastewater Tech. Assistance |
|---|---|---|---|
| Community Development Block Grants | | | |
| $22.2 million | $35 million | $2.98 million | $6.1 million |
| Water Fund (Includes Special Public Works Fund and Water/Wastewater Financing Program) | | | |
| $44.6 million | $115.9 million | $2.4 million | $1.4 million |
| Safe Drinking Water Revolving Loan Fund | | | |
| $219.7 million | n/a | $2.3 million | n/a |

**Drinking Water and Waste Water –** 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.

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. Some communities choose to finance part of their water and wastewater infrastructure capital costs by offering bonds to the market.

Congress authorized the Water Infrastructure Finance and Innovation Act (WIFIA) in 2014.[43] This new Federal fund will provide long-term, low-interest supplemental loans for large water infrastructure projects—those costing more than $20 million, or $5 million for communities smaller than 25,000 people.

**Rural Communities –** The U.S. Department of Agriculture's Rural Development program 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.

**Irrigation Districts –** The cost of delivering irrigation water 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 Irrigation Infrastructure –** Other funding sources for irrigation-related infrastructure exist at the state level as well. The Oregon Department of Fish and Wildlife offers both a cost-share program and tax credit to assist with installation of fish screening devices and passage facilities. 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.

## Funding for Watershed Restoration

Since 1999, the Oregon Watershed Enhancement Board (OWEB) has awarded more than 7,900 grants totaling more than $580 million to local volunteer efforts to keep water clean and habitats healthy. OWEB grants are primarily funded through Oregon Lottery, federal funds, and salmon license plate revenue. The majority of funds invested go directly to on-the-ground improvements of land and water such as native plantings, dam removals, irrigation efficiencies, fish passage, in-stream habitat enhancement, and land protected for future generations.

Some funds support a range of monitoring activities and grants, including baseline, compliance, status and trend, effectiveness, and validation monitoring. OWEB's investments have resulted in more than 4,600 miles of stream habitat improvements and nearly 6,000 miles of habitat made accessible for fish. Oregon consistently reports about the same length of stream mile restoration as Alaska, California, Idaho, Washington, and Pacific Northwest Tribes, combined.

On average, more than 90 cents out of every OWEB grant dollar supports local businesses, services, and suppliers. 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. According to a recent University of Oregon study, every $1 million that OWEB invests in habitat restoration creates 15-24 jobs in local communities.[44]

Oregon's watersheds also benefit from significant annual investments by the Bonneville Power Administration. In fiscal year 2015, BPA spent about $98 million on fish and wildlife programs in Oregon. Under the 2010 Willamette Wildlife Agreement, BPA began investing $144 million over 15 years for habitat protection in the Willamette River Basin.[45] These investments translate into an improvement in ecosystem conditions and enhancement of local economies.

**Focused Investment Partnerships –** Focused restoration efforts are an integral piece of OWEB's investment strategy. In 2015, the OWEB Board selected priority areas for targeted investments across the state. High performing partnerships working strategically within these priority areas are eligible to apply for Focused Investments Partnership grant funding. The funding is designed to help local partnerships scale their work strategically with multi-year, multi-million dollar investments in natural resource conservation and restoration work. In January 2016, OWEB selected six partnerships that include the Malheur Wildlife Refuge and associated wetlands, habitat for Greater Sage-Grouse in eastern Oregon, forestlands around Ashland, and habitats in the Willamette, Deschutes, and Grande Ronde river basins.

### Water Projects Grants and Loans

In 2013, the Legislature passed Senate Bill 839 creating the Water Supply Development Account.[46] Through this account, the Water Resources Department has been able to co-fund a WaterSMART Basin Study in the Deschutes River Basin with the U.S. Bureau of Reclamation and a reallocation feasibility study in the Willamette River Basin with the U.S. Army Corps of Engineers.

The state also awards grants and loans from the account through a competitive funding opportunity. These Water Project Grants and Loans provide funding to evaluate, plan, and implement instream and out-of-stream water resources projects. Since 2013, the Legislature has authorized $16.25 million.

In its first funding solicitation held in 2016, the Water Resources Department received 37 applications requesting nearly $51 million in grants and loans. The Water Resources Commission awarded approximately $9 million in funding to nine water projects. A second funding solicitation was held in early 2017. This time, the Department received 34 applications requesting $36.9 million in grants and loans. The state should continue to fund grants and loans for water projects and review and update the funding program, based on lessons learned.

**Recommended Action 13.E**
**Invest in Implementation of Water Resources Projects**

Examples of how to implement this action:

- Authorize bonds to finance these investments
- Ensure that basic maintenance needs continue to be eligible for grant and loan funding
- Advocate for continued state and federal funding for water and wastewater-related infrastructure
- Develop funding and technical support for low-income, small communities, and districts to maintain and operate water and wastewater-related infrastructure
- Continue funding and support for watershed restoration and Focused Investment Partnerships
- Continue to fund Water Project Grants and Loans
- Review and update the Water Project Grants and Loans program based on lessons learned

# Recommended Actions at a Glance

| Critical Issue | Recommended Action |
|---|---|
| Place-Based Efforts | 9.A Continue to Undertake Place-Based Integrated Water Resources Planning<br>9.B Coordinate Implementation of Existing Natural Resource Plans<br>9.C Partner with Federal Agencies, Tribes, and Neighboring States in Long-Term Water Resources Management |
| Water Management and Development | 10.A Improve Water-Use Efficiency and Water Conservation<br>10.B Improve Access to Built Storage<br>10.C Encourage Additional Water Reuse Projects<br>10.D Reach Environmental Outcomes with Non-Regulatory Alternatives<br>10.E Continue the Water Resources Development Program<br>10.F Provide an Adequate Presence in the Field<br>10.G Strengthen Oregon's Water Quantity & Water Quality Permitting Programs |
| Healthy Ecosystems | 11.A Improve Watershed Health, Resiliency, and Capacity for Natural Storage<br>11.B Develop Additional Instream Protections<br>11.C Prevent and Eradicate Invasive Species<br>11.D Protect and Restore Instream Habitat and Habitat Access for Fish and Wildlife<br>11.E Develop Additional Groundwater Protections |
| Public Health | 12.A Ensure the Safety of Oregon's Drinking Water<br>12.B Reduce the Use of and Exposure to Toxics and Other Pollutants<br>12.C Implement Water Quality Pollution Control Plans |
| Funding | 13.A Fund Development and Implementation of Oregon's Integrated Water Resources Strategy<br>13.B Fund Water Resources Management Activities at State Agencies<br>13.C Invest in Local or Regional Water-Planning Efforts<br>13.D Invest in Feasibility Studies for Water Resources Projects<br>13.E Invest in Implementation of Water Resources Projects |

# References


[1] Oregon Water Resources Department. 2015. Draft Guidelines: A Tool for Conducting Place-Based Integrated Water Resources Planning in Oregon. http://www.oregon.gov/owrd/LAW/docs/IWRS/2015_February_Draft_Place_Based_Guidelines.pdf

[2] Oregon Legislature. 2015. Senate Bill 266. https://olis.leg.state.or.us/liz/2015R1/Downloads/MeasureDocument/SB266/Enrolled

[3] U.S. Fish and Wildlife Service. 2008. 2008-2017 U.S. V. Oregon, Management Agreement. https://www.fws.gov/pacific/fisheries/hatcheryreview/Reports/snakeriver/SR--079.revised.2008-17USvOR_Mngmt_Agrmt.pdf

[4] U.S. Army Corps of Engineers and Bonneville Power Administration. 2013. U.S. Entity Regional Recommendation for the Future of the Columbia River Treaty after 2024. https://www.crt2014-2024review.gov/Files/Regional%20Recommendation%20Final,%2013%20DEC%202013.pdf

[5] State of Oregon and State of California. 2010. Klamath Basin Restoration Agreement: for the Sustainability of Public and Trust Resources and Affected Communities. https://klamathrestoration.gov/sites/klamathrestoration.gov/files/Klamath-Agreements/Klamath-Basin-Restoration-Agreement-2-18-10signed.pdf

[6] State of Oregon and State of California. 2010. Klamath Hydroelectric Settlement Agreement. http://216.119.96.156/Klamath/Klamath%20Hydroelectric%20Settlement%20Agreement%202-18-10signed.pdf

[7] U.S. Environmental Protection Agency. 2016. 2015 WaterSense Accomplishments. https://www3.epa.gov/watersense/docs/ws_accomplishments2015_3page_508.pdf

[8] League of Oregon Cities. 2015. Water, Wastewater, and Stormwater Rate Survey. http://www.orcities.org/Portals/17/Library/Water%20Rate%20Survey%203-17-15.pdf

[9] U.S. Department of Agriculture's National Agricultural Statistics Service. 2014. Farm and Ranch Irrigation Survey 2013. AC-12-SS-1. https://www.agcensus.usda.gov/Publications/2012/Online_Resources/Farm_and_Ranch_Irrigation_Survey/fris13.pdf

[10] U.S. Bureau of Reclamation. 2016. Water and Energy Efficiency Grants, Previous Grant Selections. Website. Accessed March 22, 2017. https://www.usbr.gov/watersmart/weeg/prev.html

[11] Oregon Water Resources Commission. 1992. Water Storage Policy and Principles.

[12] U.S. Congress (113th). 2014. HR 2640: Crooked River Collaborative Water Security and Jobs Act of 2014. https://www.govtrack.us/congress/bills/113/hr2640/text

[13] Oregon Water Resources Department. 2008. Above-Ground Potential Storage Project Search. http://apps.wrd.state.or.us/apps/planning/owsci/sw_project_search.aspx

[14] Clean Water Services. August 2017. Home Brew Competition to Feature Beer Made with Water from Tigard Wastewater Treatment Plant. Press Release. https://www.cleanwaterservices.org/newsroom/2017/home-brew-competition-to-feature-beer-made-with-water-from-tigard-wastewater-treatment-plant/

[15] MWH, Stantec, and Larry Walker Associates. 2016. Recommendations and Implementation Plan: NPDES Permitting Program Review. Prepared for the Oregon Department of Environmental Quality. http://www.oregon.gov/deq/FilterDocs/wqp-FinalReport.pdf

[16] State of Oregon. 1999. Oregon Plan for Salmon and Watersheds. Salem, Oregon. https://www.oregon.gov/OPSW/Pages/archived.aspx.

[17] Oregon Department of Agriculture. 2017. Agriculture Water Quality Plans Webpage. Accessed March 22, 2017. https://www.oregon.gov/ODA/programs/NaturalResources/AgWQ/Pages/AgWQPlans.aspx.

[18] Dahl, T.E. 1990. Wetlands Losses in the United States: 1780s to 1980s. U.S. Department of the Interior's U.S. Fish and Wildlife Service. Washington, D.C. https://www.fws.gov/wetlands/Documents/Wetlands-Losses-in-the-United-States-1780s-to-1980s.pdf

[19] Oregon Department of Fish and Wildlife. 2016. The Oregon Conservation Strategy. http://www.oregonconservationstrategy.org/.

[20] U.S. Fish and Wildlife Service. Beaver Restoration Guidebook: Working with Beaver to Restore Streams, Wetlands, and Floodplains. (June 30, 2015). https://www.fws.gov/oregonfwo/ToolsForLandowners/RiverScience/Documents/BRG%20v.1.0%20final%20reduced.pdf.

[21] U.S. Fish and Wildlife Services. 2017. Lower Klamath National Wildlife Refuge. Website. Accessed October 20, 2017. https://www.fws.gov/refuge/Lower_Klamath/about.html

[22] Thorne KM, Powelson KW, Bui TD, Freeman JY, Takekawa CM, Janousek CN, Buffington KJ, Elliott-Fisk DL. 2016. Assessing coastal manager science needs and disseminating science results for planning. Data Summary Report Prepared for the California and North Pacific Landscape Conservation Cooperatives. USGS Western Ecological Research Center: Vallejo, CA, 110. http://www.occri.net/media/1050/4ocar3_final_coast.pdf

[23] Oregon Board of Forestry. 2011. The Forestry Program for Oregon: A Strategy for Sustaining Oregon's Public and Private Forests http://www.oregon.gov/ODF/Board/Documents/BOF/fpfo_2011.pdf

[24] Oregon Legislature. 1971. Oregon Revised Statutes 390.805-940: Scenic Waterways Act. https://www.oregonlaws.org/ors/390.805

[25] Oregon Department of Fish and Wildlife and State Marine Board. 2016. Aquatic Invasive Species Prevention Program: Program Report. http://www.dfw.state.or.us/conservationstrategy/invasive_species/docs/AISPP_2016_Annual_Report.pdf

[26] Oregon Department of Geology and Mineral Industries. 2015. Fact Sheet on Hydraulic Fracturing in Oregon. https://olis.leg.state.or.us/liz/2017R1/Downloads/CommitteeMeetingDocument/129333

[27] U.S. Environmental Protection Agency. 2015. Environmental Justice (EJ) Screen. https://www.epa.gov/ejscreen

[28] Oregon Environmental Justice Task Force. 2016. Environmental Justice: Best Practices for Oregon's Natural Resources Agencies. https://www.oregon.gov/gov/policy/environment/environmental_justice/Documents/Oregon%20EJTF%20Handbook.v4.pdf

[29] Regional Water Providers Consortium. 2017. Source Water Protection Strategy. http://www.regionalh2o.org/sites/default/files/2017swpp-final.pdf

[30] Regional Water Providers Consortium. 2017. Source Water Protection Strategy. http://www.regionalh2o.org/sites/default/files/2017swpp-final.pdf

[31] Oregon Department of Environmental Quality. 2017. Drinking Water Protection Program Website. https://www.oregon.gov/deq/wq/programs/Pages/dwp.aspx

[32] Oregon Health Authority and Water Resources Department. 2015. Water Well Owner's Handbook: A Guide to Water Wells in Oregon. http://www.oregon.gov/owrd/pubs/docs/Well_Water_Handbook.pdf

[33] Oregon Department of Environmental Quality. 2012. Toxics Reduction Strategy: Descriptions of Actions. http://www.deq.state.or.us/toxics/docs/ToxicsStrategyNov28.pdf

[34] Office of the Governor, State of Oregon. 2012. Executive Order No. 12-05: Environmentally Friendly Purchasing and Product Design. https://www.oregon.gov/gov/Documents/executive_orders/eo_12-05.pdf

[35] Oregon Department of Agriculture, et al. 2011. Pesticide Management Plan for Water Quality Protection. https://www.oregon.gov/ODA/shared/Documents/Publications/PesticidesPARC/PesticideManagementPlanWaterQuality.pdf

[36] Barnes, K.K., et al. 2002. Water Quality Data for Pharmaceuticals, Hormones, and Other Organic Wastewater Contaminants in U.S. Streams, 1999-2000. For the U.S. Geological Survey. Open-File Report 02-94. https://toxics.usgs.gov/pubs/OFR-02-94/

[37] U.S. Environmental Protection Agency Region 10. 2014. Columbia River Toxics Reduction Working Group: Strategy for Measuring, Documenting, and Reducing Chemicals of Emerging Concern. https://www.epa.gov/sites/production/files/2014-07/documents/columbia-river-cec-strategy-july2014.pdf

[38] Oregon Department of Environmental Quality. 2011. Harmful Algal Bloom Strategy. http://www.deq.state.or.us/wq/algae/docs/AppendixE.pdf

[39] U.S. Environmental Protection Agency. 2012. Recreational Water Quality Criteria. https://www.epa.gov/sites/production/files/2015-10/documents/rwqc2012.pdf

[40] Federal Emergency Management Agency. 2017. Hazard Mitigation Plan Status. Website. Accessed March 27, 2017. https://www.fema.gov/hazard-mitigation-plan-status

[41] League of Oregon Cities. 2016. Out of Sight, Out of Mind: Funding Oregon's Water Infrastructure Needs. Local Focus. https://www.oregon.gov/owrd/LAW/docs/2016%2008%20LOC%20Infrastructure%20Needs.pdf

[42] American Society of Civil Engineers. 2017. Infrastructure Report Card - Infrastructure in Oregon. http://www.infrastructurereportcard.org/state-item/oregon/

[43] U.S. Congress. 2014. Water Infrastructure and Finance Innovation Act (WIFIA). Title V, Subtitle C. Sections 5021-5035. https://www.gpo.gov/fdsys/pkg/PLAW-113publ121/html/PLAW-113publ121.htm

[44] Nielsen-Pincus, Max and Cassandra Moseley. 2009. A Preliminary Estimate of Economic Impact and Job Creation from the Oregon Watershed Enhancement Board's Restoration Investments. Briefing Paper #13. University of Oregon's Ecosystem Workforce Program. Eugene, Oregon. http://ewp.uoregon.edu/sites/ewp.uoregon.edu/files/downloads/bp13.pdf

[45] Bonneville Power Administration and the State of Oregon. 2010. Willamette Wildlife Agreement. http://www.dfw.state.or.us/wildlife/willamette_wmp/docs/Memo_of_Agreement.pdf

[46] Oregon Legislature. 2013. Senate Bill 839. Salem, Oregon. https://olis.leg.state.or.us/liz/2013R1/Downloads/MeasureDocument/SB839

# Conclusion

As in 2012, the 2017 Integrated Water Resources Strategy relies on a foundation of science. Successfully infusing science into water-related decision-making requires information that is usable and accessible. Understanding our water resources, our demands upon those resources, and the coming pressures that affect our needs and supplies will help us meet our current and future instream and out-of-stream needs.

The reality of our national, state, and local boom and bust economic cycles will mean that implementation of Strategy may not be as robust or aggressive as desired. However, this should not curb Oregon's commitment to meeting our state's water needs, for both 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 suite of recommended actions to get us there.

Implementation of these recommended actions will occur in stages, with various public and private sector partners taking the lead.

## Steps Already Underway

Agencies that play a leadership role in Strategy will provide more details about the likely staffing needs, budget requirements, and timelines. Much of this will be developed in partnership with the Governor's Office and stakeholders as part of the Legislative process. Such detail will help signal the priorities and workload that agencies can realistically expect to undertake during the upcoming years. To be effective, agencies will need to publish regular progress reports, reflecting the actions taken by the Oregon Legislature, state agencies, and other partners to support implementation of the Integrated Water Resources Strategy.

Implementation of several recommended actions has already begun, with authorizations secured and funding already in place. Examples include the efforts to conduct additional groundwater investigations and improve water resource data collection and processing. These are basic building blocks that provide a solid foundation for decision-making and investments.

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. Funding for place-based planning, feasibility studies, and project implementation is legislatively approved through the end of the 2017-19 biennium.

Work is scheduled to continue on the water quality and public health front, with continuation of programs to ensure drinking water safety, to reduce exposure to toxics, and to implement water quality pollution control plans.

Oregon now also has a track record in water resources development with the establishment of a grant and loan program that has awarded investments in water resources projects since 2008.

## Steps Requiring Assistance from the Oregon Legislature

In order to position Oregon to better understand and meet its water needs now and into the future, the 2017 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 the capacity of the resource. These efforts also include improved monitoring of groundwater, surface water, and habitat through additional sites, improved instrumentations, continued technical training, 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 names 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 accurate groundwater and climate change information to local communities and planners, so that they can understand how potential changes in hydrological and precipitation patterns may affect their access to and management of water. New in this version is an emphasis on developing the proper statutory authorities, infrastructure, and communications systems to manage day-to-day operations as well as extreme events, such as drought, flood, and seismic events.

### Fourth, an improved ability to meet Oregon's current and future water resources needs

These recommendations call for continued efforts to help local communities conduct integrated water resources planning. They also call for continued investments in the state's grant and loan programs, notably in the management and protection of water for both consumptive and environmental needs. The recommendations point to a variety of traditional and non-traditional approaches to protect water quality, providing benefits to both public health and ecological health. Finally, the Strategy calls for a renewed commitment to identifying funding sources that can stabilize and support state agencies that have responsibility for water resources management. Recommended Action 13.B, for examples, lists those functions performed by state agencies that will require additional funds for successful implementation.

The next rendition of Oregon's Integrated Water Resources Strategy is due in 2022.

## Guiding Principles for Implementation

How Oregon carries out implementation is important as well. The State has made commitments to a number of guiding principles, including accountability, a balanced approach, collaboration, employing an open and transparent public process, reasonable cost, science-based approaches, streamlining, and other principles memorialized as part of the Strategy's development. Policy-makers responsible for furthering implementation have a duty to conduct the next phase as carefully as they did in the first. The guiding principles developed by the first Policy Advisory Group still ring true today.

**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.

**This page left intentionally blank.**

# Acronyms

| | |
|---|---|
| Ag | Agriculture |
| AgriMet | Agricultural Meteorology |
| AIS | Aquatic Invasive Species |
| ACFFOD | Amended and Corrected Findings of Fact and Order of Determination |
| ASCE | American Society of Civil Engineers |
| AR | Artificial Recharge |
| ASR | Aquifer Storage and Recovery |
| BiOp | Biological Opinion |
| CFS | Cubic Feet per Second |
| DEQ, ODEQ | Oregon Department of Environmental Quality |
| DOGAMI | Oregon Department of Geology and Mineral Industries |
| EAP | Emergency Action Plan |
| EPA | U.S. Environmental Protection Agency |
| ESA | Endangered Species Act |
| ET | Evapotranspiration |
| FEMA | Federal Emergency Management Agency |
| FTP | File Transfer Protocol |
| GDE | Groundwater Dependent Ecosystem |
| GWMA | Groundwater Management Area (DEQ designation) |
| IPCC | Intergovernmental Panel on Climate Change |
| Lidar | Airborne Light Detection and Ranging |
| M&I | Municipal and Industrial |
| METRIC | Mapping Evapo-Transpiration using high Resolution and Internalize Calibration |
| MS4 | Municipal Separate Storm Sewer System |
| MW | Megawatt |
| NASA | National Aeronautics and Space Administration |
| NOAA | National Oceanic and Atmospheric Administration |
| NPDES | National Pollutant Discharge Elimination System |
| NPS | Nonpoint Source of Pollution |
| OAR | Oregon Administrative Rule |
| OCAR | Oregon Climate Assessment Report |
| OCCRI | Oregon Climate Change Research Institute |
| ORS | Oregon Revised Statutes |
| ODFW | Oregon Department of Fish and Wildlife |
| OWEB | Oregon Watershed Enhancement Board |
| PSP | Pesticide Stewardship Partnership |
| RISA | Regional Integrated Science and Assessments |
| TAF | Thousand Acre Feet |
| TMDL | Total Maximum Daily Load |
| UICs | Underground Injection Control Systems |
| USDA | U.S. Department of Agriculture |
| USGS | U.S. Geological Survey |
| WMCP | Water Management and Conservation Plan |

**This page left intentionally blank.**

# ACKNOWLEDGEMENTS

Documents of this scope and depth are the product of a talented team and a public who cares deeply about the future of water in Oregon. With gratitude for their times, expertise, and patience, we would like to thank:

**The IWRS Project Team:**

- Alyssa Mucken, Project Manager, and Brenda Bateman, OWRD
- Anna Pakenham Stevenson and Danette Faucera, ODFW
- Ray Jaindl and Margaret Matter, ODA
- Karen Tarnow, Smita Mehta, Wade Peerman, and Heather Tugaw, ODEQ

**The Policy Advisory Group (PAG):**

- Robert "Will" Collin
- Suzanne DeLorenzo
- Arlene Dietz
- Allan Elliott
- Ron Foggin
- Rebecca Geisen
- TJ Hansell
- Valerie Kelley
- Gayle Killam
- Craig Lacy
- Hiram Li
- Tracey Liskey
- Peggy Lynch
- Curtis Martin
- Craig Pope
- Brent Stevenson
- Stan van de Wetering
- Mary Wahl

**The State Agency Advisory Group:**

- Kyle Abraham, ODF
- Lauri Aunan, GNRO
- Jevra Brown, DSL
- Sadie Carney, DLCD
- Jeff Crook, ODOT
- Curtis Cude, OHA
- Kathie Dello, OSU-OCCRI
- Tom Elliot, ODOE
- Eric Hartstein, OWEB
- William Fletcher, ODOT
- Lisa Gaines, OSU-INR
- Rob Hallyburton, DLCD
- Karen Homolac, OBDD
- Ray Jaindl, ODA
- Todd Jarvis, OSU
- Jim Johnson, ODA
- Marian Lahav, DLCD
- Ian Madin, DOGAMI
- Ashley Massey, OSMB
- Jason McClaughry, DOGAMI
- Eric Metz, DSL
- Tom Pattee, OHA
- Alex Phillips, OPRD
- Ed Tabor, OBDD

**The Federal Liaison Group:**

- Crystal Ball, BPA
- Gary Ball, USFWS
- Tony Barber, US EPA
- Kevin Brice, USACE
- Andy Bryant, NOAA-NWS
- Caty Clifton, USFS
- Christina Davis-Kernan, USBR
- Greg Fuhrer, USGS
- Laura Hicks, USACE
- Kim Kratz, NOAA
- Rosy Mazaika, BPA
- Elena Nilsen, USGS
- Scott Oviatt, USDA-NRCS
- Julia Pierko, USBR
- Joel Salter, US EPA
- Brian Staab, USFS
- Dale Stewart, BLM
- Kathryn Warner, USACE
- Julee Welch, BPA

**The Use of Artwork:**

- April Waters, https://aprilwaters.com/resources/display/home
- Susan Luckey Higdon, http://www.susanluckeyhigdon.com/

**Other State Agency Contributors and Reviewers:**

- Kiara Goldtrap, DAS
- Carlee Justis, DAS
- Jacob Edwards, DOGAMI
- Wym Mathews, ODA
- Jim Johnson, ODA
- Aaron Borisenko, ODEQ
- Courtney Brown, ODEQ
- Dan Brown, ODEQ
- Larry Brown, ODEQ
- David Cole, ODEQ
- Paul Daniello, ODEQ
- Ron Doughten, ODEQ
- Paige Evans, ODEQ
- Kara Goodwin, ODEQ
- Pat Heins, ODEQ
- Rian Hooff, ODEQ
- Paul Kennedy, ODEQ
- Kevin Masterson, ODEQ
- Ryan Michie, ODEQ
- David Pray, ODEQ
- Krista Ratliff, ODEQ
- Phil Richerson, ODEQ
- Derek Sandoz, ODEQ
- Jill Seale, ODEQ
- Amy Simpson, ODEQ
- Sheree Stewart, ODEQ
- Deb Sturdevant, ODEQ
- Gil Wistar, ODEQ
- Greg Apke, ODFW
- Jamie Anthony, ODFW
- Rick Boatner, ODFW
- Kevin Goodson, ODFW
- Andrea Hanson, ODFW
- Tim Hardin, ODFW
- Ken Homolka, ODFW
- Aaron Jenkins, ODFW
- Tucker Jones, ODFW
- Ken Loffink, ODFW
- Alan Ritchey, ODFW
- Tom Stahl, ODFW
- Erick VanDyke, ODFW
- Joy Vaughan, ODFW
- Michele Weaver, ODFW
- Kaci Radcliffe, ODOE
- Warren Cook, ODOE
- David Farrer, OHA
- Kari Salis, OHA
- Jordan Beamer, OWRD
- Rianne BeCraft, OWRD
- Lanaya Blakely, OWRD
- Kathy Boles, OWRD
- Harmony Burright, OWRD
- Kris Byrd, OWRD
- Meredith Carine, OWRD
- Gerry Clark, OWRD
- Lorri Cooper, OWRD
- Kerri Cope, OWRD
- Diana Enright, OWRD
- Kate Fitzpatrick, OWRD
- Dwight French, OWRD
- Ivan Gall, OWRD
- Kyle Gorman, OWRD
- Mary Grainey, OWRD
- Lisa Graham, OWRD
- Bob Harmon, OWRD
- Mellony Hoskinson, OWRD
- Justin Iverson, OWRD
- Tony Janicek, OWRD
- Lisa Jaramillo, OWRD
- Chris Kowitz, OWRD
- Mike Ladd, OWRD
- Rachel LovellFord, OWRD
- Mike McCord, OWRD
- Larry Menteer, OWRD
- Keith Mills, OWRD
- Kim Ogren, OWRD
- Steve Parrett, OWRD
- Tom Paul, OWRD
- Racquel Rancier, OWRD
- Ann Reece, OWRD
- Cindy Smith, OWRD
- Ken Smith, OWRD
- Lisa Snyder, OWRD
- Jason Spriet, OWRD
- Ken Stahr, OWRD
- Jon Unger, OWRD
- Doug Woodcock, OWRD

**Highlight Stories:**

- "Community Led Water Quality Testing." Charlie Plybon, Surfrider Foundation. (Ch.1, Pg. 37).
- "Connecting Consumers to Salmon-Safe Products and Places." Dan Ken, Kevin Scribner and Anna Huttel, Salmon Safe. Photos: Phil Neumann, Mainstem Malt, and Ray Terrill, Flickr Creative Commons. (Ch. 2, Pg. 58).
- "Saving Water and Energy Go Hand in Hand." Robert Wallace and Randi Wallace, WyEast RC&D. Photo: Harmony Burright, OWRD. (Ch. 3, Pg. 69).
- "Green Infrastructure Projects Designed to Improved Water Quality." Photo: Eli Bonilla, Clean Water Services. (Ch. 3, Pg. 96).
- "Modernizing Oregon's Irrigation Infrastructure." Brett Golden, Farmers Conservation Alliance. (Ch. 4, Pg. 125).
- "Restoration for Compliance in the Rogue River and Beyond." Carrie Sanneman, Tess Malijenovsky, and Kristiana Teige Witherill, Willamette Partnership; Wade Peerman, ODEQ. Photo: The Freshwater Trust. (Ch. 4, Pg. 135).
- "Investing in Habitat for Native Migratory Fish in Oregon" Nicole Maness, Willamette Partnership. Photo: ODFW. (Ch. 4, Pg. 149).
- "Pesticide Stewardship Partnership in the Clackamas River Basin." Lisa Kilders, Clackamas SWCD. Photo: Jason Faucera, Clackamas SWCD. (Ch. 4, Pg. 159).
- "Planning for Future Water Needs for Rivers, Farms, and Cities." Bureau of Reclamation; Bea Armstrong and Kate Fitzpatrick, Deschutes River Conservancy. Photo: Deschutes River Conservancy. (Ch. 4, Pg. 169)

**The Oregon Board of Agriculture:**

- Barbara Boyer, Chair
- Pete Brentano
- Stephanie Hallock
- Bryan Harper
- Tracey Liskey
- Sharon Livingston
- Laura Masterson
- Marty Myers
- Tyson Raymond
- Luisa Santamaria

**The Environmental Quality Commission:**

- Sam Baraso
- Kathleen George
- Molly Kile
- Wade Mosby

**The Fish and Wildlife Commission:**

- Michael Finley, Chair
- Holly Akenson
- Laura Anderson
- Jim Bittle
- Bruce Buckmaster
- Bob Webber
- Gregory J. Wolley

**The Water Resources Commission:**

- John Roberts, Chair
- Bob Baumgartner
- Bruce Corn
- Eric Quaempts
- Meg Reeves
- Carol Whipple
- Ray Williams

______________________________

Thomas M. Byler, Director
Oregon Water Resources Department

______________________________

Richard Whitman, Director
Oregon Department of Environmental Quality

______________________________

Curt Melcher, Director
Oregon Department of Fish and Wildlife

______________________________

Alexis Taylor, Director
Oregon Department of Agriculture

# Oregon's Integrated Water Resources Strategy Framework

Final Clean Draft: 11-06-2017

## Understand Water Resources Today

OBJECTIVES

**Further Understand Limited Water Supplies & Systems** (groundwater, surface water, and their interaction)

**Improve Water Quality & Quantity Information**

**Further Understand Our Water Management Institutions**

CRITICAL ISSUES

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

## Understand Instream and Out-of-Stream Needs

**Further Define Out-of-Stream Needs / Demands** (i.e., diverted water)

**Further Define Instream Needs / Demands** (i.e., left-in-place water)

**Understanding Oregon's Out-of-Stream Needs/Demands**

2A. Regularly update long-term water demand forecasts
2B. Improve water-use measurement & reporting
2C. Determine unadjudicated water right claims
2D. Authorize the update of water right records with contact information
2E. Regularly 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

## Understand the Coming Pressures That Affect Our Needs and Supplies

OBJECTIVES

**Economic Development** | **Water & Energy** | **Climate Change** | **Extreme Events**

**Population Growth** | **Water & Land Use** | **Water-Related Infrastructure** | **Education & Outreach**

CRITICAL ISSUES

RECOMMENDED ACTIONS

**Water & Energy**

4A. Analyze the effects on water from energy development projects & policies
4B. Take advantage of existing infrastructure to develop non-traditional 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

**Extreme Events**

5.5A. Plan and prepare for drought resiliency
5.5B. Plan and prepare for flood events
5.5C. Plan and prepare for Cascadia subduction earthquake event

**Economic Development & Population Growth**

*(See Actions 2A and 3A)*

**Water & Land Use**

6A. Improve integration of water information into land use planning (and vice versa)
6B. Improve state agency coordination
6C. Encourage low-impact development practices and green infrastructure

**Water-Related Infrastructure**

7A. Develop and upgrade water and wastewater infrastructure
7B. Encourage regional (sub-basin) approaches to water and wastewater systems
7C. Ensure public safety/dam safety

**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

## Meet Oregon's Instream and Out-of-Stream Needs

**Place-Based Efforts** | **Water Management & Development**

**Healthy Ecosystems** | **Public Health** | **Funding**

**Place-Based Efforts**

9A. Continue to 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. Continue the water resources development program
10F. Provide an adequate presence in the field
10G. Strengthen water quantity & water quality permitting programs

**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 and wildlife
11E. Develop additional groundwater protections

**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 and implementation of Oregon's IWRS
13B. Fund water resources management activities at state agencies
13C. Invest in local or regional water planning effort
13D. Invest in feasibility studies for water resources projects
13E. Invest in implementation of water resources projects

## THE WATER RESOURCES 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 2010 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.

## 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.

# Oregon's 2017 Integrated Water Resources Strategy

## Final Revised Draft: 11-06-2017

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

www.oregon.gov/owrd
waterstrategy@wrd.state.or.us

December 2017

# Table of Contents



* Note (11/22/2017): A final "Adoption Resolution" has been added to this Nov. 6, 2017 Final Revised Draft, along with a completed "Acknowledgements Section."

This page left intentionally blank.

# OREGON WATER RESOURCES COMMISSION

## Resolution Adopting the State's Integrated Water Resources Strategy

Whereas, the Oregon Water Resources Commission adopted Oregon's first Integrated Water Resources Strategy in 2012, carrying out its vision of bringing various sectors and interests together to work toward the common purpose of maintaining healthy water resources to meet the needs of Oregonians and the environment for generations to come;

Whereas, extreme weather events in recent years—droughts, fires, winter storms, and floods—continually remind us that water-related challenges are here and will only increase in the future;

Whereas, future events such as climate change and earthquakes may influence water availability, water use, and water infrastructure;

Whereas, the Water Resources Commission desires to continue, through updates to the Strategy, a strong tradition of scientific integrity, forward-looking public policy, and robust public participation in Oregon;

Whereas, by design, this 2017 Strategy retained the original vision, goals, objectives, and guiding principles from the 2012 version, with the intent to update information, fill important gaps, and strengthen ideas by shoring up or adding new recommendation actions, where needed;

Whereas, the institutions created to develop the Strategy have continued to lend their voices and knowledge—the four-agency Project Team, the 18-member Policy Advisory Group, the 18-entity Agency Advisory Group, and 10-agency Federal Liaison Group;

Whereas, the citizens of Oregon continue to demonstrate awareness and knowledge of water issues, showing strong support for collaborative solutions and contributing to the conversation through seven open houses and dozens of survey responses, attending four policy advisory group meetings, and submitting 285 public comments during a 90-day public comment period;

Whereas, our fellow Boards and Commissions have continued to support this work, the process, and product—the Environmental Quality Commission, Fish and Wildlife Commission, and the Board of Agriculture;

Whereas, the 2017 Integrated Water Resources Strategy features water-related artwork, photos, and quotes from Oregonians;

Whereas, the 2017 Integrated Water Resources Strategy includes a suite of Recommended Actions to improve our understanding of water resources, to define our collective instream and out-of-stream needs—including water quantity, water quality, and ecosystems needs—and to address the coming pressures that may affect these resources and needs;

Whereas, Oregon's update to the 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 2017 Integrated Water Resources Strategy on this Seventh Day of December, 2017.

John E. Roberts, Chair
Southwest Region

Raymond L. Williams, Vice Chair
Eastside at Large

Robert P. Baumgartner
Northwest Region

Eric J. Quaempts
North Central Region

Bruce R. Corn
Eastern Region

Carol A. Whipple
West Central Region

Meg Reeves
Westside at Large

# Foreword

**Placeholder for the Foreword**

**Placeholder for the Foreword**

# INTRODUCTION

Oregon's Integrated Water Resources Strategy (IWRS, or "the Strategy") is now five years into implementation. At the time of its adoption by the Water Resources Commission in 2012, Oregon was one of a few states without a statewide water plan. 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.

Oregon's first Strategy provided a place to document the state's successes and challenges in the water arena. The development of the Strategy proved the importance of a robust public process, thoughtful and science-based policy development, and committed leadership from both the Executive and Legislative branches of government. "Water" often competes for General Fund dollars with other important state services. The original Strategy created the momentum needed to secure the support and legal authorities to advance water resources management and protection across agencies.

The focus of the original Strategy was on the fundamental data and science that underpin water-related decisions made every day. Ideas that were merely kernels of thought in the 2012 Strategy have blossomed into important programs that represent how we do business in Oregon today. Since the release of the 2012 Strategy, Oregon has made a number of advancements in water resources management, including:

- Dedicated funding for measurement and monitoring, installing new observation wells, initiating groundwater investigations, deploying new stream gages, and expanding a cost-share fund for water use measurement devices
- Improved effectiveness monitoring on forest lands
- Established new water resources planning capacity at the Department of Agriculture and the Department of Environmental Quality
- Expanded invasive species prevention efforts through the use of boat inspection stations
- Initiated new instream flow studies and protected additional rivers by designating scenic waterways, establishing outstanding resource waters, and applying for new instream water rights
- Expanded the Pesticide Stewardship Partnership approach to new areas and continued toxics reduction efforts
- Established a statewide groundwater quality monitoring program
- Established a new planning program called place-based, integrated water resources planning with guidelines, funding, and assistance to initially support four communities with unique water challenges
- Launched a new funding program called the Water Resources Development Program. It offers grants, loans, and technical assistance for planning, feasibility studies, and water projects
- Published guidance and reports to help customers with water-related permitting, allocations of conserved water, water management and conservation plans, and long-term demand forecasts
- Added capacity for inter-agency coordination and collaboration

## The 2017 Edition

The Strategy is meant to be a living document, developed and implemented using an iterative process. The authorizing statute (ORS 536.220) requires a review and update of the Strategy every five years. This 2017 Strategy continues to build upon the goals, objectives, guiding principles, and actions of the first Strategy, allowing the Water Resources Commission and its sister boards and commissions to continue championing it as before.

The fundamental purpose of this document is to better understand and meet Oregon's water needs—both consumptive and environmental—while including water quantity, water quality, and ecosystem needs.

The 2017 Strategy renews its emphasis on data and information, describing ways in which the state and its partners can infuse science into their decision-making. Relying on a foundation of science means that information must be usable and accessible. This document highlights examples where science is and should continue to be integrated into public policy—through analysis and studies; through delivery to internet and mobile devices; during training, education, and outreach; as inputs to statute and rule; as inputs into permitting, regulatory, and funding decisions; and as a basis for water supply, water efficiency, and habitat restoration projects.

The 2017 Strategy introduces nine new recommended actions:

- Planning and preparing for droughts [5.5A], floods [5.5B], and the Cascadia earthquake [5.5C]
- Ensuring public safety/dam safety [7.C]
- Providing an adequate presence in the field [10.F]
- Strengthening water quantity and water quality permitting programs [10.G]
- Developing additional groundwater protections [11.E]
- Investing in local or regional water planning efforts [13.C]
- Investing in implementation of water resources projects [13.E]

The 2017 Strategy once again spells out "what" generally needs to happen, but not the finer details of implementation. For that level of detail, agencies will need to engage their stakeholders in a workplan exercise that specifies priorities, necessary budget resources, staffing, and timing.

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—financial or technical— or new policies could serve as powerful tools for progress. It also identifies where public and private partnerships could stretch our dollars and further instream and out-of-stream efforts. Just as importantly, the 2017 Integrated Water Resources Strategy does not remove or jeopardize existing water rights or other local, state, tribal, and federal authorizations. The Strategy does not relinquish any existing authorities.

## Cross-Cutting Issues

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

**Groundwater:** The health and future of Oregon's groundwater resources were featured in several important venues during 2016-17, including discussions of the Water Resources Commission, media articles, a Secretary of State audit, testimony before legislative committees, and discussions of the Integrated Water Resources Strategy Policy Advisory Group. The Water Resources Commission and Policy Advisory Group have both called for a long-term plan for sustainable groundwater management.

Oregon agencies monitor and manage groundwater at the state level, tracking groundwater-level trends and groundwater quality, providing information to local planners and other decision-makers, making science-based permitting decisions, and managing surface water and groundwater conjunctively. The 2017 Strategy contains recommended actions to advance the collection and processing of groundwater data, as well as the management and protection of groundwater resources. Recommended actions throughout the document that touch upon land-use planning, infrastructure, permitting, field presence, environmental health, public health, and funding all have a groundwater nexus.

**Climate Change and Extreme Events:** Oregon cannot simply rely on the past to predict the future. We must develop a broader understanding of the range of hydrologic possibilities. The 2017 Strategy discusses a changing climate, calling for continuous monitoring of its effects and actions that are necessary to address climate change.

The Governor's 2015 Executive Order 15-09 focused on drought resiliency, instructing agencies to include the topic in the 2017 Strategy. The resulting recommendations point to a suite of tools and approaches, including increased water conservation and efficiency efforts, expanded natural and built storage, and strengthened resiliency of riparian areas, forest lands, wetlands, and floodplains.

**Funding and Investments:** None of the recommended actions in this document can succeed without investment of dollars, time, energy, and expertise. For reasons of brevity, the reader will not see funding requests in each chapter; however, assume that all of the recommended actions require some level of funding support. Recommended Action 13.B, in particular, notes where state agencies have responsibilities that require budget dollars for successful implementation. Today, the agencies that protect and manage Oregon's natural resources receive less than two-percent of the General Fund. Water management receives an even thinner slice of that investment.

**Collaborative Solutions:** As members of the 2016 Policy Advisory Group and the public pointed out, the "place" where communities come together to collaborate with public agencies, academic institutions, non-profits and private sector partners to address water challenges is fertile ground for testing and trying the approaches described throughout the Integrated Water Resources Strategy.

These are places where agencies and citizens can collaborate on data collection and monitoring; where stakeholders can help quantify water needs; where land-use planning and zoning influence water resources; and where we improve our resiliency to extreme weather events. A diverse array of interests are collaborating on water issues – some are planning for future water needs, while others are developing innovative projects or programs that provide multiple benefits. Collaborative approaches to water are featured throughout the Strategy.

## Organization of the Document

Oregon's 2017 Integrated Water Resources Strategy provides a blueprint to help the state focus its efforts around two key goals—improving our understanding of Oregon's water resources, and meeting Oregon's water resources needs.

The document is organized into four main chapters that cover the four objectives of the Strategy. Both the goals and the objectives reflect the authorizing legislation.

Goal 1: Improve our understanding of Oregon's water resources
- Chapter 1 (Objective 1): Understand water resources today
- Chapter 2 (Objective 2): Understand instream and out-of-stream needs
- Chapter 3 (Objective 3): Understand the coming pressures that affect our needs and supplies

Goal 2: Meet Oregon's water resources needs
- Chapter 4 (Objective 4): Meet Oregon's instream and out-of-stream needs

Within each chapter are sections that describe the "critical issues" facing the state. These were developed and vetted with support from advisory groups, agencies, and public input. Each critical issue is addressed by a series of "recommended actions." Altogether, the 2017 Integrated Water Resources Strategy contains 51 recommended actions, each one supported with a set of bulleted items about how one might implement that action. Each chapter concludes with an at-a-glance summary of the recommended actions contained in each chapter.

## A Vision for the Future

Changes are coming as a result of aging water infrastructure, a warming climate, and an influx of people moving to Oregon from warmer, drier regions. These changes are already evident in the water scarcity that persists throughout the state, particularly on the east side. This scarcity affects the decisions of farmers and ranchers, cities, industry, and other water users, and places increased pressure on the ecological health of river systems and aquifers and the plant and animal species that depend on them for survival.

The already-existing tensions between competing uses and priorities are likely to be exacerbated by these coming pressures, making them even more challenging to reconcile. With this in mind, this draft Strategy lays out a number of proactive recommendations that help meet our current and future water needs.

The Policy Advisory Group that helped craft the original Strategy offered a vision that still holds true today, noting that:

> **"50 years from now, our vision is to see everywhere in our state 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.
>
> **~ Policy Advisory Group (2010)**

The Policy Advisory Group that helped craft the 2017 Strategy offered more specific observations about the water challenges we face today and how to address them:

> **"Water is a finite resource with growing demands; water scarcity is a reality in Oregon. Water-related decisions should rest on a thorough analysis of supply, the demand / need for water, the potential for increasing efficiencies and conservation, and alternative ways to meet these demands."**
>
> **~ Policy Advisory Group (2016)**

# CHAPTER 1

## Understand Water Resources Today

Water is one of our 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.

Oregon has a continuing need to understand its water resources. This includes the form and timing of precipitation, the amount of streamflow, the location and volume of groundwater, the quality of the water, and overall accessibility to communities, fish, and wildlife. The state and its partners serve as stewards of this public resource—managing water simultaneously for economic development, human health and safety, and for environmental protection.

The 2017 Integrated Water Resources Strategy continues to be a product of inter-agency collaboration. Chief among these efforts is a commitment to thoughtful and robust data collection, analysis, and sharing information with those engaged in water management and decision-making.

**Quick Links to Main Sections:**

# Critical Issue – Further Understand Limited Water Supplies and Systems

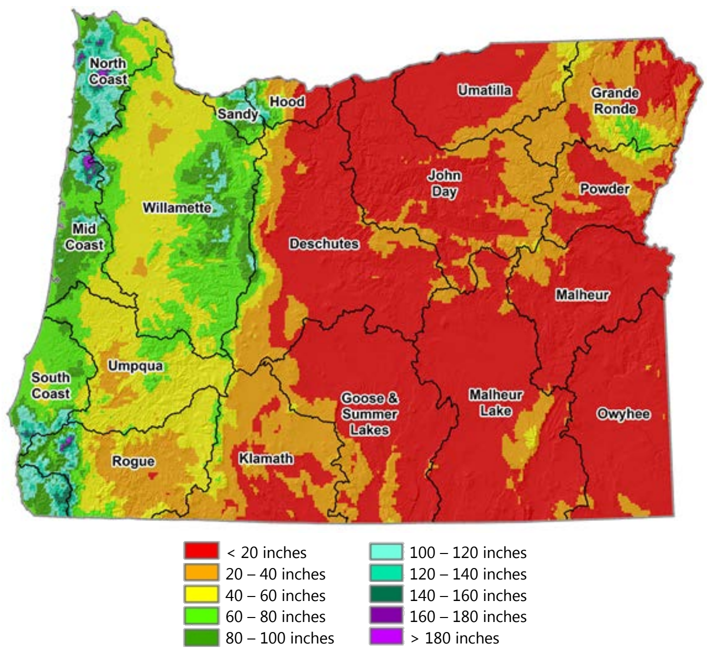
In an average year, Oregon's lakes, streams, and aquifers accommodate an estimated 100 million acre-feet of water.[1] Water moves through the land, rock, soils, plants, mountains and valleys at different rates and volumes, fluctuating throughout the year. The dynamic nature of water makes it challenging to quantify. Understanding how this complex system works is the key to effectively managing Oregon's water resources.

## Precipitation

Oregon receives a majority of its precipitation in the fall and winter. In general, Oregon has a rather mild winter climate. The climate of the western third of the state is characterized by moderate temperatures, wet winters, and dry summers; about 78 percent of the annual precipitation occurs in the period October to March. The eastern portion of the state, on the other hand, has greater extremes of temperature but somewhat less seasonal variation in precipitation. On the east side, about 65 percent of the precipitation occurs in the period October to March.

The Cascade Range, about 90 miles inland from the Pacific Ocean, lies parallel to the coastline and acts as a natural barrier to marine air masses and the prevailing westerly winds. This causes significant statewide variation in annual rainfall, as shown in Figure 1-1. In western Oregon, average annual precipitation ranges from 200 inches in places in the Coast Range to less than 40 inches on the Willamette Valley floor, and less than 10 inches in parts of north-central and south-eastern Oregon. In the winter, much of the precipitation falls as snow at altitudes above 3,500 feet.

**Figure 1-1: Average Annual Precipitation**



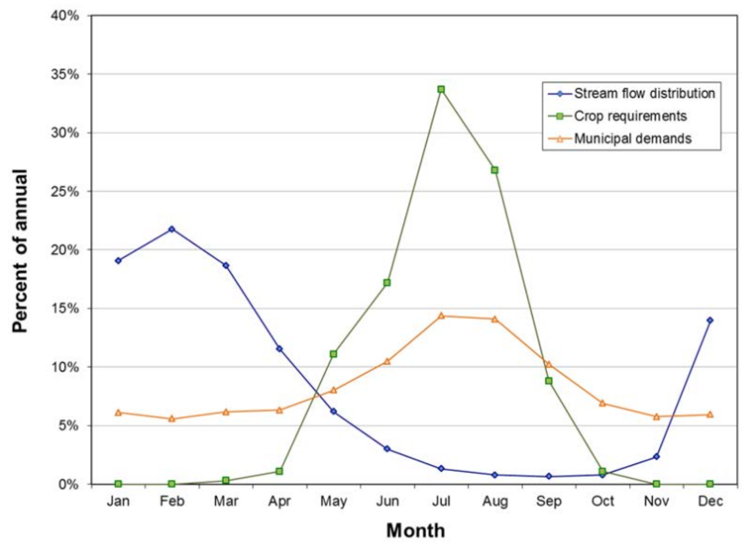

Precipitation does not arrive all at once, but in a series of seasonal storms or events, each generating a unique combination of responses from the effected watersheds. These responses are influenced by numerous physical characteristics within the watershed that in turn affect surface water runoff patterns and groundwater recharge, as well as plant uptake and evaporation.

## Surface Water

Surface water runoff is relatively abundant in Oregon, but it is unevenly distributed with respect to location and timing. Major river systems drain the Coast Range, Cascades, Klamath, Blue, and Wallowa Mountains, and the terminal lake basins of the Great Basin. Each of these areas has a distinct topography and plant community, which interact with climate and geology to produce unique runoff patterns. Floods may occur every few years in the humid, western part of the state. Although less frequent, floods are not uncommon in the semiarid eastern region. Water shortages common to eastern Oregon can also occur in the western side of the state, especially during dry summers. Snow, and the timing of when it melts, plays a major role in shaping annual hydrographs.

The arrival of precipitation in Oregon, whether by rain or snow, stands in stark contrast to the months in which water demands are at their peak for most uses. The accompanying graph shown in Figure 1-2 demonstrates this mismatch in timing between supply and out-of-stream demand. The green line represents crop requirements that peak in demand during the months of June, July, and August. The red line represents municipal and domestic use that also peaks in the summer months. The blue line, by contrast, represents typical streamflow distribution in western Oregon, hitting a trough during those same summer months.

**Figure 1-2: Example of Streamflow vs. Demand**




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

## Surface Water Availability

The Oregon Water Resources Department has created and continues to maintain a database of the amount of surface water available for new appropriations for most waters in the state. This database is used to evaluate new water right applications. Most of the surface water resources in Oregon are fully allocated during the summer months.

**Figure 1-3: Available Streamflow in August**
(calculated at 80 percent exceedance)

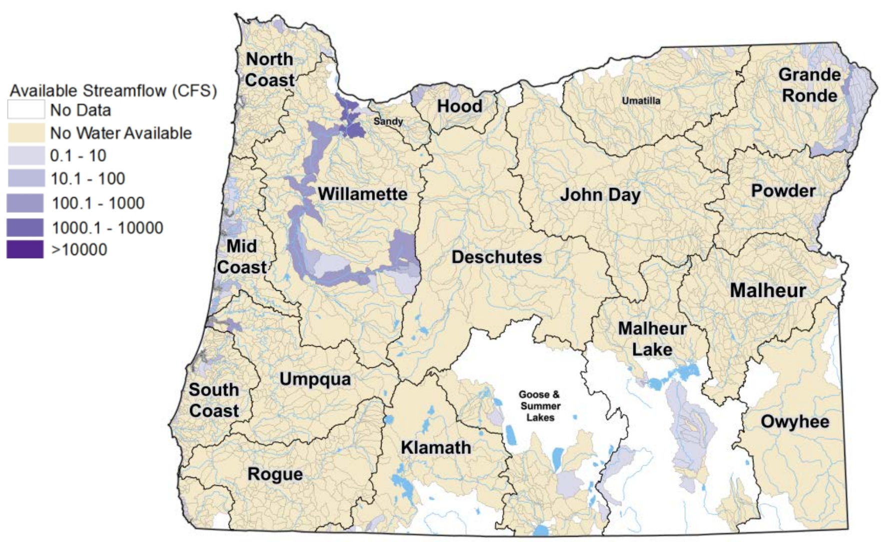
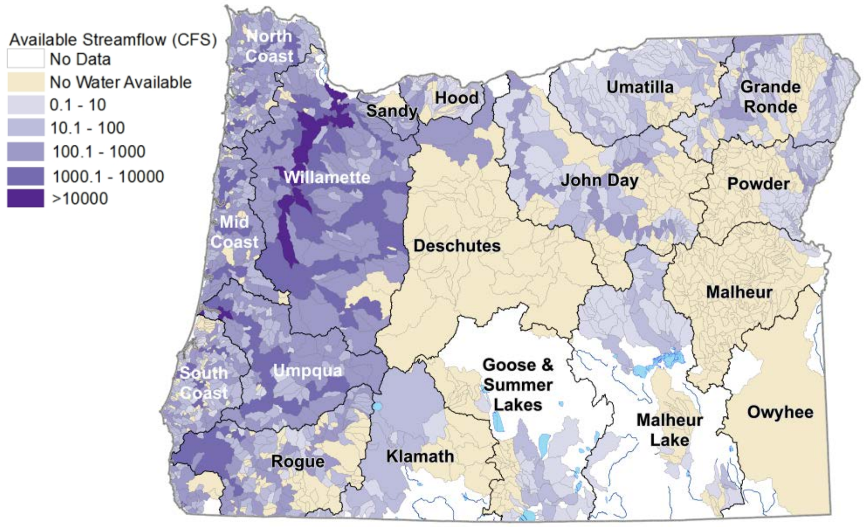



Figure 1-3 shows (in blue) where water is available for live flow allocation during the month of August, the month most representative of low summer flows and high out-of-stream demands. With some exceptions, the mostly-tan map indicates that throughout the state, very little surface water is available to allocate for new uses during August.

Increasingly, water users are relying on tools such as water conservation, reuse, water right transfers, and water storage to meet their needs during the summer months. Some of these tools are designed to benefit instream flow.

Some water is available during the winter months to allocate for new out-of-stream uses or protect instream uses. Figure 1-4 illustrates (in blue) water availability for new uses during the month of January. Many water users, with authorization, store available surface water during the winter and early spring to supplement their water supplies.

**Figure 1-4: Available Streamflow in January**
(calculated at 50 percent exceedance)

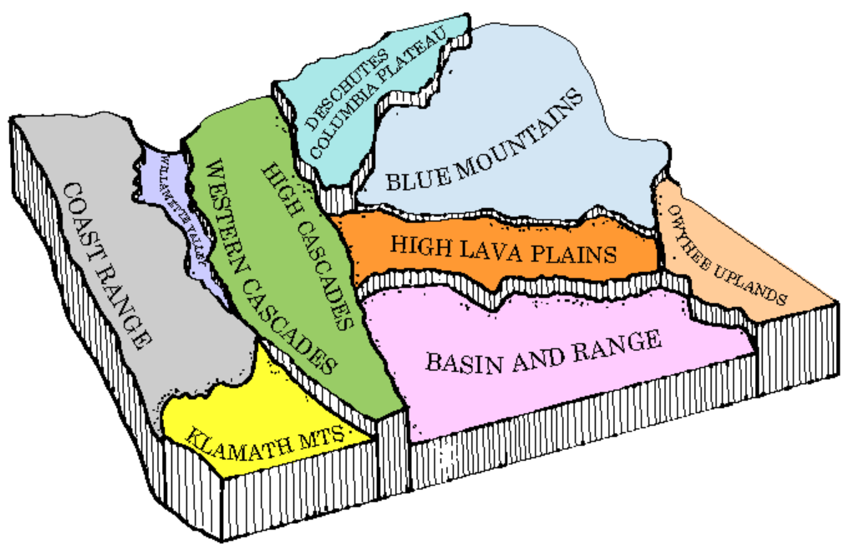



## Groundwater

Groundwater occurs almost everywhere beneath the land surface. However, the ability of rock and sediment to accept recharge and transmit groundwater varies greatly throughout the state based on hydrogeologic characteristics. Oregon's most productive regional aquifer systems occur in the Willamette Valley, High Cascades, and Deschutes-Columbia geologic provinces (Figure 1-5). However, productive local aquifers exist throughout the state and most geologic formations or rock types in Oregon are capable of producing at least small quantities of potable water suitable for domestic use.

Recharge to groundwater occurs from many sources, including rainfall, snowmelt, irrigation and other artificial systems. Water that has infiltrated to the groundwater system flows along subsurface pathways under the forces of gravity and pressure, and ultimately exits the groundwater system through discharge to surface water bodies, vegetation uptake, and appropriation through wells. Movement of groundwater is relatively slow (feet or less per year, as opposed to feet per second as surface water flow is commonly measured) and its residence time underground varies from days to millennia.

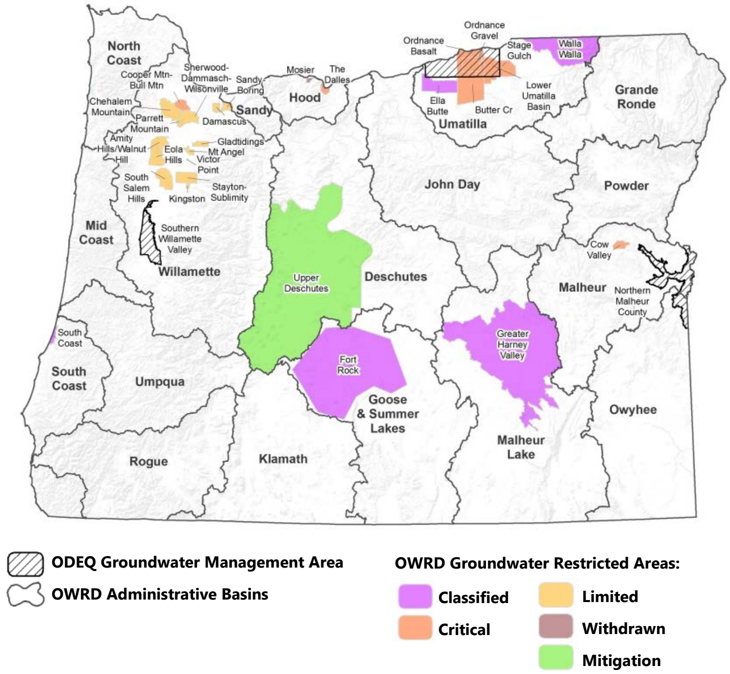
**Figure 1-5: Major Geologic Provinces of Oregon**



## Groundwater Availability

Groundwater development has occurred primarily in areas where the geologic conditions are favorable or where additional surface water is no longer available for new allocations. In some locations, groundwater aquifers are no longer capable of sustaining additional development. In the Willamette Valley, for example, 14 areas have been completely withdrawn from future uses or limited to a few uses, such as domestic use or fire protection.

**Figure 1-5: Groundwater Administrative Areas**
(Quality & Quantity)




The limitations of groundwater include groundwater quality, as some aquifers contain saline water, while others contain area-wide nitrate contamination, making the water unfit for human consumption. Groundwater contamination is a serious issue in some locations in Oregon, affecting portions of Linn, Lane, and Benton Counties, the Lower Umatilla Basin, and northern portions of Malheur County. Refer to Figure 1-6 for areas administratively designated, due to known groundwater issues.

## Groundwater – Surface Water Interaction

Groundwater is connected to surface water, and because Oregon water law recognizes this important connection, the state manages these resources as one. This is called conjunctive management.

The hydraulic connection of groundwater to surface water means that groundwater use can deplete streamflow. However, this depletion is often difficult to measure or is delayed in effect, making conjunctive management a challenge.

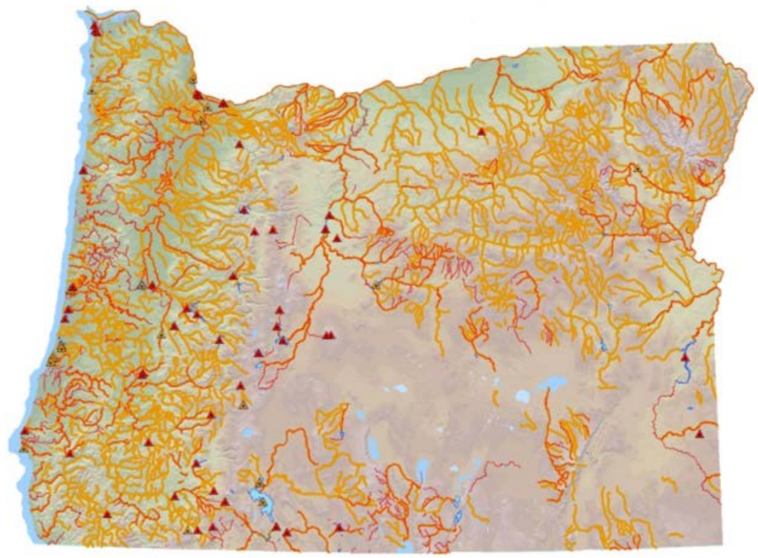
Generally, the Water Resources Department denies, limits, or requires mitigation for new groundwater applications in instances where use from an aquifer could substantially interfere with a surface water source that is already fully appropriated. One example of conjunctive management stems from a 2001 study[2] conducted by the Water Resources Department and U.S. Geological Survey that quantified the hydraulic connection between groundwater and surface water within portions of the Deschutes River Basin. 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.

## Surface Water Quality

Temperature, sedimentation, and nutrients are the most common types of pollution 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.

Streamflow is a key factor in calculating pollution concentrations. Some pollutants, such as temperature, dissolved oxygen, and bacteria, are more likely to reach harmful levels when streamflow is low. Other pollutants, such as sediment, are more likely to reach harmful levels with high flows.

**Figure 1-6: Surface Water Quality**
Water Quality Limited Waters – 2010 Integrated Report




More than 1,530 water bodies are impaired and not meeting water quality standards, including more than 70 lakes and reservoirs, and about 24,500 stream miles. The accompanying map (see Figure 1-7), based on DEQ's 2010 Integrated Report for the Clean Water Act, 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. Oregon submitted its 2012 Integrated Report for approval to the U.S. Environmental Protection Agency in November 2014; it was partially approved in December 2016.

A TMDL is the calculated pollutant amount that a waterbody can receive and still meet water quality standards. Note that waters on the accompanying map are shown as needing a TMDL (in red) until all have been completed for that waterbody. In other words, some waterbodies are impaired by more than one pollutant and may need additional TMDLs completed.

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

## Groundwater Quality

Groundwater contamination is also a serious issue in some areas of Oregon. Private domestic wells may face contamination issues from nearby failing septic systems. Industry and agriculture can also be a source of pollutants for groundwater, as can surface water and groundwater interactions. In public water supplies, routine monitoring and ambient groundwater quality studies over the past 20 years have found that 35 of 45 study areas show some impairment or reason for concern.

Most of DEQ's groundwater monitoring efforts target vulnerable areas or areas of known contamination (i.e., Groundwater Management Areas (GWMAs)). Nitrate is one of the most commonly analyzed contaminants in these areas, with data showing that around 30 percent of groundwater samples detect nitrate at levels that suggest a pollution problem exists (7 mg/L), and around 20 percent currently exceed health standards (10 mg/L). Bacteria are a commonly detected contaminant as well, with about 20 percent of samples showing positive bacteria detections. Arsenic is not as commonly studied, but when sampled in vulnerable groundwater areas, about 30 percent of samples show levels above health standards (10 ug/L).

Other contaminants detected in groundwater studies include Dacthal, manganese, lead, iron, aluminum, perchlorate, uranium and vanadium. There have been few studies that investigate contaminants such as current use and legacy pesticides, herbicides, pharmaceuticals, personal care products and volatile organic compounds. Based on data collected in the past five years, when detections of those contaminants are found, they are often far below health standards, if any standards exist.

The Department of Environmental Quality conducts groundwater quality studies in new areas of the state each year, focusing on areas where groundwater may be especially vulnerable to contamination as well as areas where little data exists. The Department of Environmental Quality shares this information with local groundwater users to inform them about their drinking water quality and potential contamination risks.

## Ecosystem Health

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 can offer early warning signs of stress, such as disease or pollution.

Such indicator species include native salmonids (salmon, steelhead, and trout) that depend on cold, clean water. Since 1991, the National Oceanic and Atmospheric Administration's Fisheries Office of Protected Resources, which monitors anadromous species, has listed 15 out of 23 species of salmon and steelhead found in Oregon under the Endangered Species Act. To date none of them have been delisted.

In addition to these indicator species, the U.S. Fish and Wildlife Service has listed eight non-anadromous fish species. These are fish that reside year-round in Oregon's rivers and streams.

The high number of fish species listed as threatened or endangered is partially related to dwindling water quality and quantity in many areas of the state during critical life history periods and can be an indicator of inadequate ecosystem health. Recovery efforts by local, state, tribal, and federal entities are underway for these listed species, which include improving access to habitat, increasing habitat quantity, and improving habitat quality.

As a result of these efforts, the U.S. Fish and Wildlife Service announced the removal of the Oregon chub and Modoc sucker and their associated critical habitat from the list of Endangered and Threatened Species in 2015, making them the first to be delisted due to recovery. In addition, the status of two other Oregon species are also improving; Borax Lake Chub and the Foskett Spring Speckled Dace are proposed to be delisted or reclassified in the near future.

Improving freshwater ecosystem health provides benefits beyond those important to these indicator species. All Oregonians benefit from a healthy aquatic ecosystem and the services it provides as freshwater is vital to human life and economic well-being. Ecosystem services provide clean air, clean and abundant water, fish and wildlife habitat and other values that are generally considered public goods. Impacts to indicator species can serve as an early warning sign of broader impacts to the benefits that Oregonians enjoy as a result of natural processes and biological diversity.

# Critical Issue – Improve Water Quality and Water Quantity Information

Improving our knowledge of water resources requires investments in inter-agency work, analytical methods and approaches, scientific modeling tools, and platforms to share information with the public and other partners.

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 water monitoring programs.

Data-sharing among agencies supports informed decisions and more efficient management of water resources. As one example, the Department of Environmental Quality and Department of Fish and Wildlife provide information and advice to properly evaluate water allocation decisions made by the Water Resources Department. Their understanding of species and water quality needs helps determine whether a proposed use of water is in the public interest.

As another example, the Department of Forestry uses water right information from the Water Resources Department to determine whether forest streams are sources of domestic drinking water. Streams that serve as a drinking water source trigger more stringent forestry protections. There are many 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.

[Note: the following text formally appeared as Figure 1-8 in the public review draft:] The state needs to maintain and add to its monitoring networks to augment its long-term record, fulfill its day-to-day management responsibilities, and identify changing trends. Installing and maintaining additional monitoring stations such as observation wells, streamflow gages, rain gages, snow survey equipment, soil moisture sensors, and AgriMet weather stations will need to be done in strategic locations, and will need to answer a growing list of questions. For many of these, monitoring stations will be more effective if they are paired, such as an observation well in tandem with a stream gage, or a snow survey measurement site with an observation well.

## Monitor and Evaluate Groundwater Levels

Accurate location information and water-level data are critical for assessing 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. Today, there are nearly 380 active state observation wells, in addition to about 500 project measurement wells in Oregon. Since 2013, the Oregon Legislature has provided funds to help expand the Water Resources Department's network of dedicated observation wells, providing staff with year-round access to make measurements. The process of siting these wells is spelled out in more detail in the Department's 2016 Monitoring Strategy.[3] Expanding the network of observation wells is often needed in basins where the state plans to pursue cooperative groundwater studies in partnership with the U.S. Geological Survey.

### Conduct Groundwater Basin Studies

Oregon has a need for additional basin studies 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 cooperative, cost-share programs. These investigations result in a conceptual model of the basin, including a description of the geology of the basin and a water budget, showing overall volumes of groundwater recharge, discharge, and dynamic storage. A numerical groundwater flow model is also developed and used to better understand the outcome of potential management scenarios.

The Water Resources Department has completed cooperative basin studies in three areas (Deschutes, Willamette, and Klamath) and is currently working with the U.S. Geological Survey to study the Harney Basin. The state has prioritized additional basins for subsequent groundwater studies. Priority areas include:

- The Umatilla Basin's Walla Walla Sub-Basin, where senior basalt groundwater users are not receiving their usual and customary amount of water.
- The Umatilla Basin's Lower Umatilla Sub-Basin, where senior surface water users are asking the Department for help in addressing the cumulative impacts of alluvial and shallow basalt groundwater development.
- The Hood Basin's Fifteen Mile Creek, where there are declining groundwater levels and indications that groundwater extraction is affecting surface water flow.
- The Grande Ronde Basin, where residents have asked the Department to identify potentially available groundwater and to describe potential over-allocation.
- The Powder Basin, where the county and community have asked the Department to identify potentially available groundwater and to describe potential over-allocation.

### Evaluate Groundwater Administrative Areas

The Water Resources Department oversees more than 20 groundwater administrative areas, which include limited or "classified" areas, critical areas, and withdrawn areas, designated to prevent further water level declines.

Groundwater limited areas contain a number of five-year groundwater permits. These permits are scheduled to expire at different times. It would be more efficient to review these time-limited permits at the same time, providing more consistent reviews for well owners and making better use of the reviewers' time.

Groundwater administrative 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. Some previously designated areas may need to have designations changed or borders adjusted. In addition, the state needs to dedicate resources to determine whether additional areas require groundwater designations, and if so, to what degree. Such areas could include portions of the Umatilla, Hood, Willamette, Deschutes, and Klamath Basins.

**Recommended Action 1.A**
**Conduct Additional Groundwater Investigations**

Examples of how to implement this action:

- Install and maintain dedicated state observation wells in priority basins
- Partner with U.S. Geological Survey to conduct and cost-share additional groundwater recharge studies and basin investigations
- Evaluate groundwater administrative areas; review time-limited permits more efficiently
- Locate and document water wells, including exempt use wells, permitted wells, and unused wells
- Ensure high-quality groundwater level measurements; install measuring tubes and make scheduled measurements

### Improve Groundwater-Related Records

Well owners, consultants, and agencies need better information about Oregon's water wells, some examples are described below.

**Water Well Location Information –** Oregon currently has inadequate documentation of the number, location, and average water use of water wells. Wells were not required to be registered with the state until 1955. Since then, most well location information has been reported 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 exempt-use wells, which are most often used for domestic purposes. An estimated 230,000 such wells exist today, with several thousand more drilled each year. In 2014, the state updated its online mapping program to help well drillers and landowners record the location of new, existing, and unused water wells—including both exempt-use wells and permitted wells.

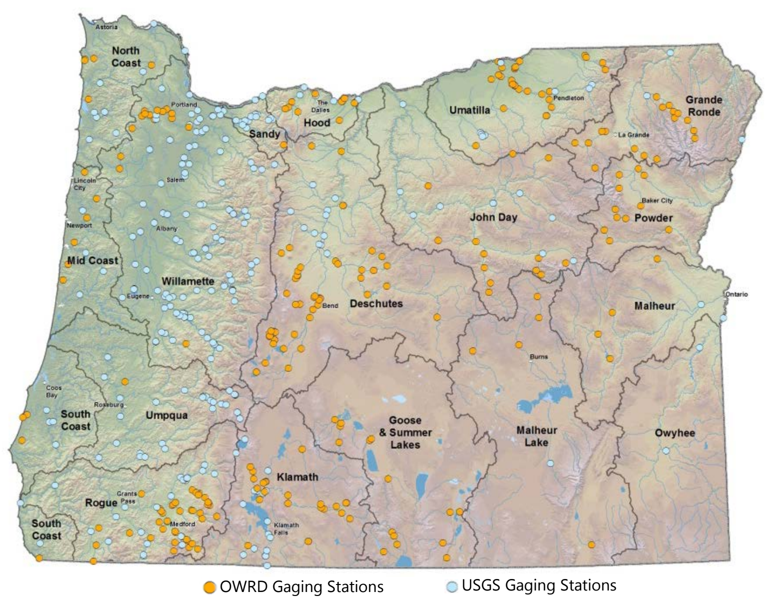
**Water-Level Access –** Measuring tubes help to ensure that accurate measurements or samples can be taken in water wells, without getting tangled in pumps or wires. Several locations in Oregon, such as Eola Hills in Polk County, Pete's Mountain in Clackamas County, and Mosier in Wasco County have requirements to install measuring tubes during new well construction.

**Scheduled Measurements –** Agency scientists collect baseline information at the start of each irrigation season, before any significant groundwater pumping begins. This activity is a high priority because it contributes to Oregon's long-term understanding of the resource. If measurements are not taken each spring, opportunity for measurement—and therefore good information—is lost.

## Monitor and Evaluate Surface Water Flows

The Water Resources Department operates more than 250 stream and reservoir gages throughout the state, maintaining an extensive long-term record for many of them. This network of gages informs water planning, permitting, and management decisions. About 200 of these gages are operated as near real-time, and transmit data once every hour. It is the state's intent to continue to grow and maintain this network. Since 2013, the Oregon Legislature has dedicated funds to help expand and maintain the state's stream gaging network. The Department also provides access to data from an additional 345 gages, primarily from the U.S. Geological Survey (USGS).

**Figure 1-8: Active Surface Water Gaging Stations**




Operating a stream gage network requires trained hydrographic technicians to keep the equipment operating properly, to conduct regular measurements at various stream gages, 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.

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 Department of Environmental Quality (DEQ), for example, uses streamflow data to calculate the loading capacity of certain pollutants during development of TMDL plans to improve water quality.

Currently, the state lacks sufficient capacity to maintain and process data from its network of stream gages in a timely fashion. This has resulted in a backlog of unprocessed records and has hindered the Department's ability to share valuable water resources information. The public can access these records in their provisional state, but not in final form.

## Monitor and Evaluate Groundwater Quality

During the past few decades, dwindling budget resources and other water quality priorities have significantly decreased groundwater quality protection efforts. In the early 1990s, DEQ had 12 staff dedicated to the groundwater quality program. By the early 2000s, program staff had decreased to five. The groundwater program only consisted of technical assistance, minimal statewide coordination, and implementation of groundwater monitoring and restoration activities in three designated Groundwater Management Areas (GWMAs) — Northern Malheur County, the Lower Umatilla Basin, and the Southern Willamette Valley.

To obtain a more comprehensive understanding of the water quality conditions of groundwater resources outside of the GWMAs, the 2013 Oregon Legislature provided funds for DEQ to implement a Statewide Groundwater Monitoring Program. It was designed to monitor groundwater for contaminants of concern, including nitrates and pesticides, in two geographic regions per year. The data and information developed will be used to determine: areas of the state that are especially vulnerable to groundwater contamination; long term trends in groundwater quality; status of ambient groundwater quality; emerging groundwater quality problems; and potential risks from contamination.

In 2015, DEQ conducted its first groundwater quality study under its statewide program in the mid-Rogue River Basin, sampling approximately 100 domestic wells over two sampling events in the spring and fall. Similar studies in the North Coast basins of Clatsop and Tillamook counties and the Walla Walla River Basin in Umatilla County followed. In 2017, sampling took place in the Mid-Willamette Valley surrounding Salem; DEQ is making plans for a 2018 study. DEQ is collecting high-quality data on nitrate, arsenic, coliform bacteria, pesticides, as well as pharmaceuticals and other select contaminants based on local risk factors and program capacity. By 2018, approximately 370 wells will have been tested under this program.

DEQ identifies areas of groundwater contamination, as well as potential health risks from the contaminated groundwater, informing each user of this risk and providing educational and technical resources to address those risks. For each study area, DEQ provides a brief data summary and technical report, along with a public presentation of results. Currently, resources are not available for an in-depth analysis of the results, but the data are available for the public and outside organizations to use to support local programs and outreach activities.

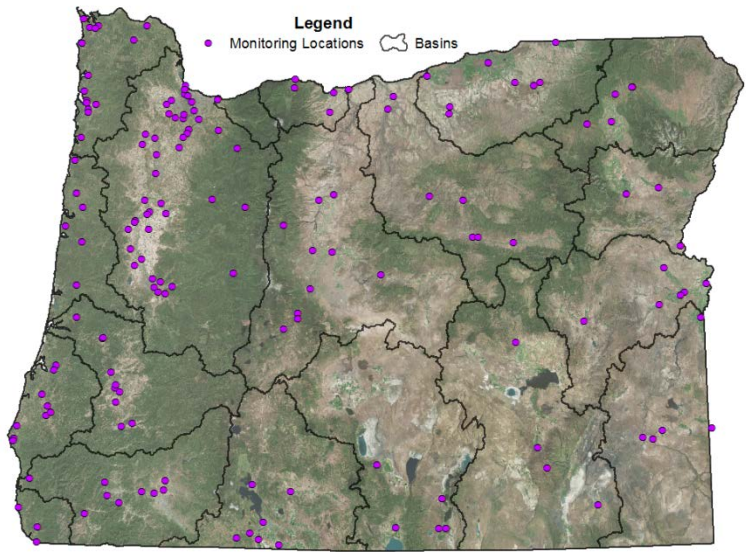
With continued funding, DEQ plans to rotate to new study areas around the state and will be working closely with local organizations and interested participants. Continuation of this type of collaborative and widespread monitoring will help fill in data gaps and begin to identify long-term trends in groundwater quality.

**Testing Water Quality in Private Drinking Water Wells –** Private drinking water supply wells are not routinely tested for water quality issues, 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. The data provides a broad overview of groundwater quality in the state. Most domestic well tests (88 percent) show nitrate levels below 3 milligrams/liter (mg/L), reflecting background groundwater quality. Approximately 12 percent of the tests show nitrate levels above background groundwater quality. About 1.6 percent of the wells tested exceeded the federal drinking water standard of 10 mg/L. Regarding arsenic, 63 percent of tests did not detect any while 10 percent of the tests detected arsenic at levels above EPA's Safe Drinking Water Standard (SDWS) of 10 micrograms/liter (ug/L).

## Monitor and Evaluate Surface Water Quality

Water quality standards are established by the state to ensure that our lakes and streams support multiple beneficial uses, including protection of public health, recreational activity, and aquatic life. Water quality monitoring data and information on status and trends defines the priorities and sets the direction for programs and activities aimed at protecting and restoring water quality. State agencies and partners utilize water quality monitoring data to update water quality standards, determine causes of impairment, develop water quality improvement plans (Total Maximum Daily Loads), establish permit limits, notify the public of health advisories, measure project and program effectiveness and modify program strategies as needed to improve water quality outcomes.

**Figure 1-9: Ambient Water Quality Monitoring Stations**
November 2017




The Department of Environmental Quality monitors and evaluates water quality through a variety of programs that provide information on Oregon's waterbodies. Some of these activities are statewide assessments of water quality, whereas others focus on geographically-specific assessments of water quality or narrow categories of pollutants and/or beneficial uses. Established monitoring programs and projects include:

- Ambient monitoring network and Oregon Water Quality Index (OWQI)
- Watershed monitoring (TMDLs)
- Toxics monitoring
- Biomonitoring
- Oregon Beach Monitoring Program
- Volunteer water quality monitoring
- Groundwater monitoring
- National aquatic resource surveys
- Drinking water protection
- Other special projects

Although the state has several monitoring programs, the geographic scope and frequency of data collection and analysis is limited due to resource constraints. Water quality data is not available for all waterbodies and all pollution types, and therefore the assessment is not comprehensive. With more resources for monitoring and data analysis, more impaired waterbodies may be identified and begin the process towards meeting Oregon's water quality standards for the protection of public health and aquatic life. Monitoring data are also pivotal for ensuring that water quality improvement strategies and investments are cost-effective and achieve the desired results.

## Monitor and Evaluate Habitat Conditions and Watershed Functions

The Oregon 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 the change in river channels over time, 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.

The Oregon Watershed Enhancement Board keeps a restoration inventory of more than 17,000 completed projects 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 essential to ensure effective and efficient restoration. The Department of Fish and Wildlife, for example, plans to update streamflow priority restoration areas using new species distribution and climate change information.

Recognizing that further investments in monitoring are needed and given the limited funding and staffing resources, Oregon is in the process of creating guidance for prioritizing watersheds/basins for data collection and monitoring. There are some watershed-based tools available today to prioritize sensitive water bodies and habitat for future restoration efforts. These include Endangered Species Act Recovery Plans, the Department of Fish and Wildlife's Oregon Conservation Strategy, watershed assessments and action plans, along with tools from the Department of State Lands, such as the Oregon rapid wetland assessment protocol, the stream functional assessment method, and streamflow duration assessment method.

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

Examples of how to implement this action:

- Use agencies' monitoring strategies, or similar methods, to design, expand, and maintain real-time monitoring networks
- Prioritize basins for data collection and monitoring
- Establish quality assurance procedures to verify the accuracy of water use and other data
- Improve agency capacity to collect and analyze data, bringing records to final form
- Implement an on-going state-wide groundwater quality monitoring program
- Update water quality standards and develop additional TMDLs
- Increase the number of stream gages with reportable water temperature data to support water quality programs
- Help homeowners test water quality in private drinking water wells; update real estate transaction database
- Monitor habitat and watershed conditions and evaluate the effectiveness of restoration efforts

# Critical Issue – Further Understand Our Water Management Institutions

No agency has sole jurisdiction when it comes to water management. In Oregon, water belongs to the public, and there are many public and private organizations with specific responsibilities and authorities related to the management of water resources. These organizations reside at the local, state, federal, and tribal level and each has a different mission, funding base, and constituency.

Stakeholders have expressed frustration over the difficulty agencies have coordinating policies, reconciling sometimes different missions, and gaining much-needed efficiencies. Although the Strategy contains many necessary recommended actions, it remains difficult to coordinate and strengthen connections between and among them because of the numerous agencies involved. Decision-makers must recognize that making these connections takes additional time, staff, and resources on the part of agencies and their partners.

Such connections include groundwater and surface water interactions, supply and demand analyses, instream and out-of-stream uses, water quality and water quantity challenges, and land-use and water management. The opportunity to focus on these connections may come during future budget and policy discussions, local initiatives, permitting, or collaborative efforts, such as place-based planning.

The 2017 Strategy recognizes the importance of Oregon's legal, scientific, and institutional foundation and commits to continuing and strengthening it. Oregon has set the standard among states in several areas of water resources policy and innovation.

## How Water Quantity is Managed

### Doctrine of Prior Appropriation

Since 1909, Oregon's Water Code has created a system of water allocation and distribution throughout the state. With few exceptions, water 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 state authorization, although some uses are exempt from permitting requirements. 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. For more details, read *Water Rights in Oregon: An Introduction to Oregon's Water Laws.*[4]

### Permits

[Note: flipped order of these two paragraphs]. The Water Resources Department administers almost 90,000 water rights, which includes both permits and certificates, for both instream and out-of-stream uses, and on a daily basis it evaluates applications for new water use permits and changes to existing rights. Unlike the interconnected relationship the Oregon Department of Environmental Quality and Oregon Health Authority have with the U.S. Environmental Protection Agency, there is no federal agency counterpart that oversees the functions performed by the Water Resources Department.

In 1989, the Water Resources Commission directed the Water Resources Department to develop an allocation policy and establish a water availability program. A decision support tool was developed using on a historic hydrologic record to help evaluate whether new water use applications would be able to utilize surface water at least 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 and diminish surface water flows. When Oregon evaluates new requests for out-of-stream uses, it takes into account various factors, such as the needs of existing users, including established instream protections, as well as potential impacts to sensitive, threatened, or endangered fish species.

# Timeline of Water Resources Management

Many of the laws, plans, and policies noted in the following timeline represent major achievements and serve as a strong foundation for economic development, environmental restoration, and protection of human health in Oregon.

**1889** Oregon enacts a state law prohibiting pollution of waters used for domestic or livestock purposes

**1898** Oregon's first fish screening law protects fish from injury or mortality in diversion ditches, machinery, or irrigated fields

**1909** Oregon Water Code creates a system of water allocation and distribution

**1927** Oregon Legislature establishes requirements for obtaining water rights for the use of groundwater in eastern Oregon

**1929** Oregon Legislature establishes current dam safety laws

**1955** Oregon's Ground Water Act authorizes the state's management of groundwater resources statewide

**1955** Oregon's Minimum Perennial Streamflow Act creates minimum flow requirements to support fish and aquatic life or minimize pollution

**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

**1967** Oregon's Removal-Fill Law, established in 1967 and amended in 1971, requires landowners who plan to remove or fill materials in wetlands or waterways to obtain a permit from the Department of State Lands

**1970** Oregon Scenic Waterways Act maintains the free-flowing character of designated rivers and lakes in order 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

**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 land use plans

**1974** Federal Safe Drinking Water Act, later amended in 1996, regulates the quality of drinking water delivered through community water systems

**1987** Oregon's Instream Water Right Act recognizes water instream as a beneficial use and authorizes instream water rights

**1989** Oregon's Groundwater Quality Protection Act is passed to conserve, restore, and maintain the high quality of Oregon's groundwater

**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** Oregon's 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 needs for fish

**2001** Oregon's State Tribal Government-to-Government Law passed, directing state agencies to include tribes in the development of programs

**2005** The Deschutes Groundwater Mitigation Program was developed to provide for new groundwater uses while maintaining scenic waterway and instream water right flows in the Deschutes Basin

**2006** The Oregon Conservation Strategy provides an 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 involving natural resources

**2008** Oregon Legislature authorizes a grant funding program for feasibility studies of water storage, reuse, and conservation projects

**2009** Oregon Legislature establishes an Ecosystem Services Policy, focusing on the protection of land, water, air, soil, and native flora and fauna

**2010** The Environmental Quality Commission revises water quality and human health standards based on a Fish Consumption Rate of 175 grams per day per person—the most protective criteria in the nation

**2011** The Environmental Quality Commission approved rules allowing the issuance of Graywater Permits to reduce demand on other sources, such as potable water, surface water and groundwater

**2012** Oregon adopts its first Integrated Water Resources Strategy, a blueprint for meeting the state's instream and out-of-stream needs

**2013** Oregon delivers the Klamath Adjudication Findings of Fact and Order of Determination to Klamath County Circuit Court

**2013** Oregon Legislature authorizes a Water Supply Development Account, funding the implementation of water resources development projects

**2015** The Oregon Chub and Modoc Sucker are the first and only de-listings of fish species under the Endangered Species Act

**2015** The Oregon Legislature provides initial funding for Place-Based Integrated Water Resources Planning

**2017** The Oregon Environmental Quality Commission designates the North Fork of the Smith River as Oregon's first Outstanding Resource Water

## How Water Quality is Protected

### The Clean Water Act

The primary regulatory tool used to reduce or prevent pollutants from entering surface waters is the Federal Clean Water Act, which requires states to establish water quality standards to protect all beneficial uses of water. Indian tribes also have authority under the Clean Water Act to adopt and implement water quality standards within reservations. In Oregon, the Department of Environmental Quality (DEQ) administers the Clean Water Act with oversight from the U.S. Environmental Protection Agency.

According to the Clean Water Act, each state must assess the quality of water bodies across the state. The state must then develop Total Maximum Daily Loads (TMDLs) and implementation plans for all waterbodies that do not meet the state's water quality standards. Certain federal, state, and local governments and agencies, including cities, counties, and special districts become Designated Management Agencies with authority to manage and regulate water pollution resulting from many different sources that are listed in the TMDL.

### Permits

To regulate the discharge of pollutants from point sources (e.g., the pipe of an industrial facility or wastewater treatment plant), Oregon DEQ issues National Pollutant Discharge Elimination System (NPDES) permits. DEQ also issues Water Pollution Control Facility (WPCF) permits to regulate the point source discharge of wastewater onto land. Both of these permits limit the amount of pollution that can be discharged and require that specific practices be followed to protect surface waters and groundwater aquifers. Permittees are required to monitor and report discharges to DEQ, which then reviews these reports and conducts site inspections to ensure that permittees comply with the requirements.

Oregon DEQ also reviews new water right applications, offering guidance on whether the proposed use complies with existing state and federal water quality standards.

For livestock operations, the Oregon Department of Agriculture is the lead agency responsible for issuing Confined Animal Feeding Operation (CAFO) permits to owners so manure does not pollute ground and surface water.

### Other Relevant Water Quality Laws

In 1993, the Oregon legislature passed the Agricultural Water Quality Management Act, enabling the Oregon Department of Agriculture to develop plans and rules to prevent and control water pollution from agricultural activities in order to achieve water quality standards. The Act is part of the state's effort to address the federal Clean Water Act and it serves as the foundation for the state's Agricultural Water Quality Program, ensuring that farmers and ranchers do their part in meeting water quality standards. There are 38 Agricultural Water Quality Management Area Plans and Rules around the state. Water quality specialists with the Department of Agriculture work with farmers, ranchers, community leaders, and other stakeholders who serve as members of local advisory committees for each management area. Each committee identifies local agricultural water quality problems and opportunities for improvement.

The Oregon Legislature passed the Forest Practices Act in 1971, the first law of its kind in the United States at that time. The Act and its rules have been changed many times in response to new scientific findings and evolving public needs and interests. The Forest Practices Act sets standards for all commercial activities involving the establishment, management, or harvesting of trees on forestlands. Many of the rules are aimed at protecting water sources. For example, regulations require landowners to leave forested buffers and other vegetation along streams, wetlands, and lakes to protect water quality and fish and wildlife habitat. The Oregon Board of Forestry has primary responsibility to interpret the Act and to set rules for forest practices. The forestry laws have created a partnership between the Department of Forestry, landowners, and operators to achieve efficient and effective resource protection. Department policy, carried out on the ground by stewardship foresters, ensures compliance through a balance of science-based rules, incentives, educational and technical assistance, and uniform enforcement.

The Groundwater Quality Protection Act was adopted in 1989 in recognition of the need to prevent contamination of groundwater resources, to conserve and restore the resource, and to maintain the high quality of Oregon's groundwater resources for present and future uses. All state agencies' rules and programs must be consistent with the goal of protecting drinking water resources and public health. The Department of Environmental Quality has primary responsibility for implementing groundwater protection in Oregon and uses a combination of water quality and land use programs to implement the Act. Other state agencies also play a role in groundwater management and protection.

## How Ecosystems Are Protected

### The Endangered Species Act

The purpose of the federal Endangered Species Act (ESA) is to protect and recover endangered or threatened species and the ecosystems upon which they depend. "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 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.

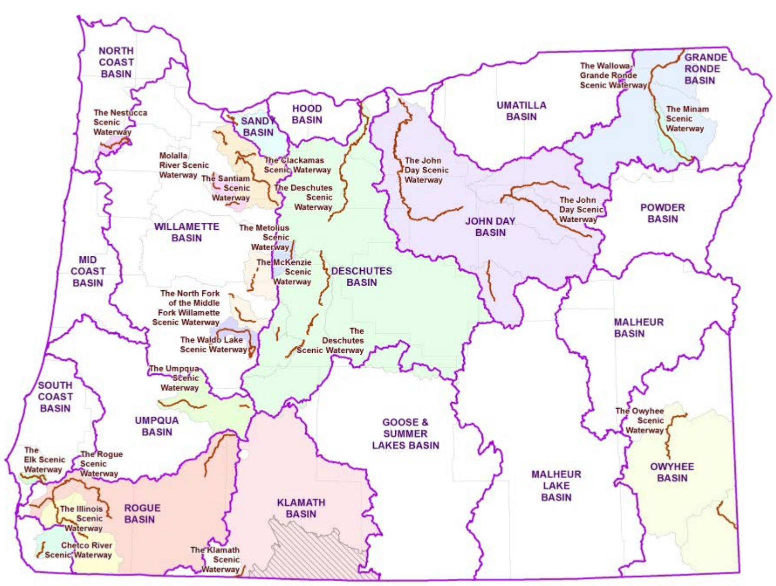
Led by the Department of Fish and Wildlife, Oregon participates in the development of recovery plans for its ESA-listed fish species. These plans provide an informed, strategic approach to recovery that is based on science and supported by stakeholders. They allow for adaptive management over time as new information is acquired. Coordinated action with citizens, and other local, state and federal agencies is essential for successful implementation.

### Oregon's Scenic Waterways Act

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 Waterways Act has created one of the most extensive scenic waterway systems in the country, with more than 1,100 river miles protected. 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.

The Scenic Waterways Act 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, if groundwater pumping (individually or cumulatively) will measurably

**Figure 1-7: State Scenic Waterways and Contributing Areas**

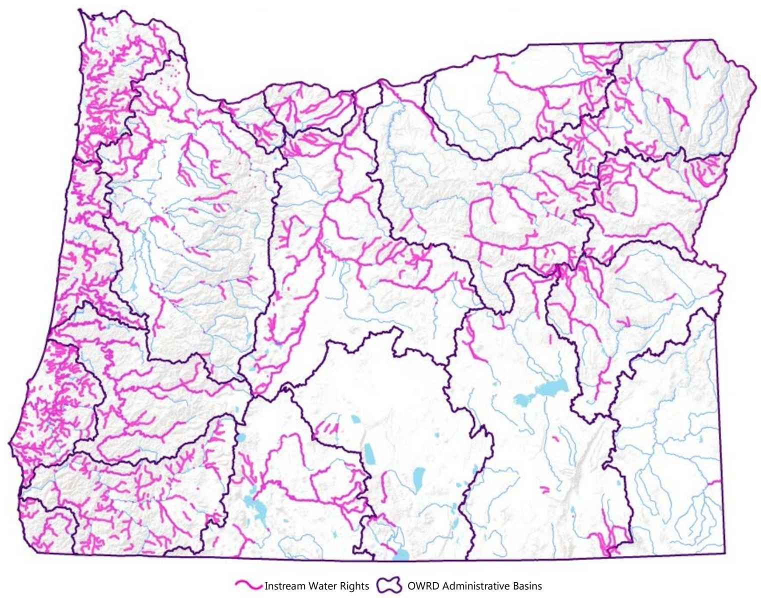


reduce surface water flows. Land use activities that can affect a scenic waterway or adjacent land—such as constructing roads or buildings, mining, and forest harvesting—are limited or regulated by this Act. The Oregon Parks and Recreation Department has primary responsibility for implementing the Scenic Waterways Act and consults with several natural resources agencies, including the Water Resources Department.

### Oregon's Instream Water Right Act

Oregon's 1987 Instream Water Right Act was designed to protect instream flows by establishing instream water rights. The Department of Fish and Wildlife, Parks and Recreation Department, and Department of Environmental Quality can submit applications to protect water instream. More than 900 instream rights have been established through this process, and are 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 for in the same way as other out-of-stream water rights, though many of them are junior to out-of-stream uses. Junior instream water rights are generally not being met, particularly in the summer months, but do establish flow targets necessary to set basic protections for aquatic life.

**Figure 1-8: Instream Water Rights**




Even as far back as the 1950s, Oregon put streamflow protections in place to support aquatic life and protect water quality. The state has converted more than 500 of these older protections, called "minimum perennial streamflows," into instream water rights.

Since adoption of Oregon's Integrated Water Resources Strategy in 2012, the Department of Fish and Wildlife has been working to prepare additional instream water right applications to help achieve the state's instream goals. The first applications were submitted to the Water Resources Department in 2016.

### Fish Screening & Passage Laws [new sub-title, new location]

Oregon established its first fish screening laws more than 100 years ago. Screens prevent fish from being caught in water diversion structures. Further, in locations where native migratory fish are currently or have historically been present, fish passage over man-made dams and diversions has also been a requirement since before statehood. Today, the state requires 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.

### No-Net Loss Wetland Policy [new sub-title, new location]

Although Oregon's wetland management and protection authorities 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 (coastal) wetlands, administered by the Department of Land Conservation and Development.

## How Public Health Is Protected

The 1974 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 Safe Drinking Water Act requires the U.S. Environmental Protection Agency to establish and enforce standards that public drinking water systems must follow. The EPA delegates primary enforcement responsibility (called primacy) to state and tribal governments, with certain requirements.

### Is it Safe to Drink? [New heading]

The Safe Drinking Water Act was amended in 1986 and 1996. The Act and these amendments created a coordinated set of programs and requirements to help water system operators make sure communities have a safe supply of drinking 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. More than 3,400 public water systems serve 89 percent of Oregon's population, or about 3.4 million people. Oregon's public water systems are fed by more than 200 surface water diversions, nearly 4,000 groundwater wells, and 225 springs. Each year, drinking water providers must report to their customers the results of mandatory water quality testing they perform on their potable water supplies.

**Addressing the Causes of Waterborne Diseases –** In the 1970s, Oregon experienced 15 waterborne disease outbreaks, including events at Crater Lake National Park in southern Oregon and Government Camp on Mt. Hood. Events such as these illustrated the need for rigorous national drinking water standards.

Although Oregon initially declined sole responsibility, or "primacy," for the 1974 Safe Drinking Water Act, the state did establish its own program in the early 1980s. The program operated in tandem with the U.S. Environmental Protection Agency until Oregon assumed primacy in 1986.

Oregon focused on the continuing community waterborne disease problem, whose root cause was the use of unfiltered surface water sources from forested mountain watersheds. Although crystal clear, these sources contained environmental pathogens, especially Giardia. Fifty-five Oregon communities with unfiltered surface water sources installed treatment, connected to others, or drilled wells because of the 1975 EPA turbidity standard (i.e., cloudiness of water).

An additional 161 water systems with unfiltered surface water or groundwater sources (under the influence of surface water) made improvements due to treatment requirements established under the 1986 amendments. Only a few unfiltered communities in Oregon qualified for filtration exceptions and are now required to make improvements to meet cryptosporidium treatment requirements established under the 1996 amendments.

Even today, water systems can experience difficulties with waterborne diseases. Baker City, for example, uses an unfiltered surface water supply and experienced a cryptosporidium outbreak in 2016, and the City of Portland took its unfiltered Bull Run water supply temporarily off-line in early 2017 due to cryptosporidium detections as well. In May 2017, the Oregon Health Authority notified Portland that it would have to begin treating Bull Run water for cryptosporidium, and in August 2017, the city council voted to pursue filtration as the preferred treatment option.

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.

**Most Common Contaminants in Public Drinking Water —** In Oregon public water systems, the most commonly found contaminants are arsenic, disinfection by-products, lead, copper, and nitrate. Arsenic is usually naturally occurring due to the volcanic nature of the state's geology. Small levels of nitrate can also be naturally occurring; however, higher levels are often due to the influence of human or animal waste or fertilizers. The Oregon Health Authority requires public water systems to notify their customers in the event of high levels of contaminants, and to apply treatment or use an alternate source.

The presence of lead in drinking water has garnered national attention in recent years. The unsafe lead levels found in Flint, Michigan's public water system in 2014 ultimately led to the EPA issuing an emergency order to protect public health and make sure the public has access to testing and sampling results.[5]

Fortunately, few of Oregon's public water distribution systems contain lead components. However, lead can leach from home or building plumbing into the water. Some water providers treat their source water to reduce corrosivity and thus, lead at the tap. In August 2016, the Oregon Board of Education adopted new rules mandating that school districts and public charter schools submit a plan to test for lead and communicate the findings.[6] More information on reducing lead exposure can be found at healthoregon.org/lead.

## Is It Safe to Swim? [New section and heading]

While generally it is considered safe to swim in Oregon's lakes and streams, each waterbody has a unique watershed and pollutants can reach the water from many potential sources.

Exposure to bacteria is the greatest health concern for people swimming or wading in lakes, streams, and coastal waters. Ingesting bacteria can cause gastrointestinal illness. Bacteria can wash into the water following heavy rains from various sources including overland flow from agricultural areas, stormwater discharges from urban areas, and sanitary sewer overflow events. When washed into warm stagnant waterbodies, bacteria multiply faster than they die off resulting in increased concentrations. Several agencies are responsible for monitoring and regulating potential sources of bacteria to ensure Oregon's waters are safe for recreational activities. For example, DEQ regulates wastewater discharges and urban stormwater discharges, ODA regulates bacteria sources on agricultural lands, and OHA and DEQ work together to monitor bacteria levels in coastal areas.

Harmful algal blooms (HABs) are another health risk to swimmers and waders. Most often harmful algal blooms in freshwaters are caused by cyanobacteria, which are not actually algae, but a type of photosynthetic bacteria. More information on HABs can be found in Chapter 4.

## Is It Safe to Eat the Fish? [New section and heading]

There are some pollutants in Oregon's waterbodies that are found at levels too low to be a concern when swimming or wading. Yet, fish and other aquatic life can bioaccumulate the pollutants in their flesh and become a health risk for people that eat them. Examples of these pollutants include metals, pesticides, pharmaceuticals, polychlorinated biphenyls (PCBs-now banned), dioxins/furans, and polycyclic aromatic hydrocarbons.

**Mercury, An Example –** Mercury is a naturally occurring element that is found in air, water, and soil and exists in several different forms. Methylmercury is the organic form of mercury that most easily enters the body. It can be naturally formed in the soil or water by certain types of bacteria. A number of factors influence the formation of methylmercury. For example, methylmercury is more likely to form in a water body where there is a high amount of organic material or where algal blooms are prone to occur. Methylmercury increases in concentration as it moves up the food chain and is the form of mercury most toxic to humans. Because methylmercury bioaccumulates, consuming fish is the most common way people become exposed to mercury.

Oregon DEQ, in conjunction with its partner agencies, collects fish tissue samples from Oregon waters to monitor the level of mercury in fish. Results of these analyses indicate that some resident fish from rivers and lakes throughout the state have levels of mercury in fish tissue higher than the state methylmercury standard of 0.040 mg/kg. Northern pikeminnow and bass are commonly sampled fish and live as predators or bottom-feeders. Therefore, these fish tend to have higher levels of mercury in their tissue. Non-resident fish, such as salmon and steelhead have not been included in DEQ studies because they spend limited time feeding in Oregon rivers or lakes and generally contain lower levels of mercury. Sampling fish for mercury and other toxics is an important part of DEQ's monitoring strategy and it will continue to be part of its long-term toxics monitoring program.

## Enhance Data Coordination

Monitoring Oregon's waterways is not limited to just state agencies. There are several federal agencies whose data collection and analysis are critical to the understanding and management of Oregon's surface water and groundwater resources. The Natural Resources Conservation Service, the National Weather Service, and the United States Geological Survey are three such agencies. Three additional federal agencies, the Army Corps of Engineers, Bureau of Reclamation, and the Bonneville Power Administration are key partners in the operation and management of key pieces of water infrastructure, including reservoirs used for power production, irrigation, and flood control.

Several years' worth of water quantity and quality data still needs to be processed, analyzed, and shared with the public and other partners. Methods to enhance data collection, processing and sharing include:

- Coordination – Better integrating federal, state, and local data collection efforts, while adhering to quality control standards
- Training – Improving data collection standards, manuals, training, and technical support
- Access – Providing on-line platforms for data submittal and quality control
- Real-Time – Adding remote and real-time monitoring to existing stations
- Backlogs – Processing the backlog of water quantity and water quality 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 presents a significant, ongoing challenge.

### Make Water-Related Information Available Electronically

Water-related program information, contact information, and data are often not available from state agencies, or sometimes difficult to find and use. Agencies try to keep fact sheets and how-to-guides accurate and up-to-date. 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 entering backlogged information and making it available.

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 data more interactive. Agencies at all levels of government need to upgrade websites, file transfer protocol or "FTP" sites, and other electronic means to make water-related information readily available and usable. The Water Resources Department has a number of web services accessible to the public, such as water rights, well logs, and streamflow data. In just one year—from July 2016 to June 2017—streamflow data from the Department's online database was accessed more than 287,000 times.

Students and stakeholders have asked whether they could write applications supported by hand-held devices, repackaging agency information for public use. In an era of crowd sourcing and open source code, this is an example of open standards (i.e., providing the public access to agency data for use on multiple platforms). Supporting such efforts can extend the reach and use of agency information more quickly than agencies can deliver on their own.

**Highlight Box**

**Community Led Water Quality Testing**

There's no question that Oregonians like to play on the beach. Recreational opportunities on our beaches attract tourists to coastal communities. Clean water supports healthy beaches, healthy communities, and a healthy economy and that's why Surfrider Foundation is using citizen science to identify water quality issues on Oregon's beaches and work collaboratively towards solutions.

Surfrider's Blue Water Task Force Program currently operates 7 different labs in Oregon and regularly monitors water quality at nearly 40 different sites along the coast. These efforts are solely funded through local chapter fundraising efforts and operate through partnerships with schools, aquariums, watershed councils, and non-governmental organizations. This 100 percent volunteer run program tests water quality at popular beaches and five marine reserves year round, supplementing the state's Beach Monitoring Program, which only tests during the summer months.

Trained lab volunteers and youth help run the analysis of the samples in the lab, incubating them for 24 hours and posting the results the following day on the National Blue Water Task Force site and sharing information through social media, newsletters, and local media. This allows members of the public to get regular updates on the health of Oregon's beaches and know whether beaches are safe for recreation.

"Surfrider worked with us to chase down some tricky water quality issues on our beaches and helped us figure out solutions. Thanks to their efforts we now have a strong partnership and work together to make measureable improvements in beach water quality."
Tim Gross, City of Newport

Find more information at: http://www.surfrider.org/blue-water-task-force.

## Develop Decision-Support Tools

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

[Note: the following text was moved up from paragraph 5 in this sub-section]. The state needs to invest in the tools and science needed for developing and testing future scenarios. Developed transparently and at the appropriate local scale, such scenarios can become powerful tools for decision-making and help prioritize investments in water resources projects, including economic development, flow, and habitat restoration efforts

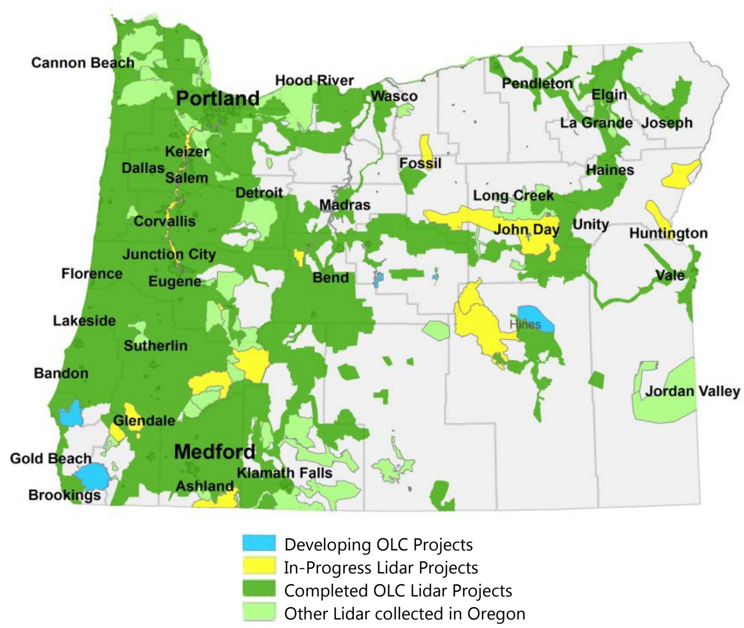
Various decision-support tools are described in more detail throughout this document and include: the Water Availability Reporting System, a Drought Early Warning System, Mapping Evapo-Transpiration using high Resolution and Internalized Calibration (METRIC), groundwater recharge studies and groundwater basin studies, instream flow studies, water quality monitoring programs, floodplain restoration programs, and precipitation/flood forecasting tools. These existing modeling and other decision-support tools need to be periodically updated.

For instance, the Water Availability Reporting System was established in the 1990s for the purposes of calculating the amount of water available for allocation. The underlying hydrologic data is from a 30-year period, 1958 through 1987. Science agencies, including the National Weather Service and Natural Resources Conservation Service update their base period every ten years and are now working from a base from 1980 to 2010. The Water Resources Department proposes to update its system to match those same base years.

### Encourage Inter-Agency Work

The state could do better when it comes to integrating agency functions related to water. In 2015, the state "mapped" Oregon's Major Water-Related Institutions,[7] creating a document showing their involvement in water resources management at the local, state, federal, and tribal levels. This mapping document describes each entity's area of responsibility, relevant programs, and available data. The document was developed to strengthen the public's understanding of inter-agency linkages. It may also help identify areas where agencies can improve coordination in data collection, field work, and decision-making. Such a tool is difficult to keep up-to-date and should be revised regularly.

**Figure 1-12: Lidar Coverage in Oregon** [note: new map]




One example where agencies have recently collaborated is in the review of water right permit applications. The Departments of Fish and Wildlife, Environmental Quality, and Water Resources have revisited their forms, process flow, and online collaborative workspace in order to process applications more efficiently and consistently.

Another example of collaboration is the state's Lidar Program (Airborne Light Detection and Ranging). This is a remote sensing tool that provides three-dimensional surface terrain data for the state.

In 2007, the Oregon Legislature designated the Department of Geology and Mineral Industries (DOGAMI) as the lead agency for lidar acquisition in Oregon. DOGAMI established the Oregon Lidar Consortium (OLC) in order to build funding for the acquisition of large swaths of lidar across the state. These data help create geologic maps, flood hazard maps, evaluate tidal channel topography, locate infrastructure, model water quality, delineate wetlands, evaluate habitat restoration, assess hazards, and inventory forests.

To date, the Oregon Lidar Consortium has completed 66 large lidar collections totaling nearly 49,000 square miles. Excluding serial lidar data sets, the Consortium has collected lidar for 45 percent of the state, covering 94 percent of the populated areas. The lidar coverage includes all of the Willamette Valley, the entire coast of Oregon, the western portions of the I-84 corridor, as well as recent completions of the Rogue and Deschutes Basins. Refer to Figure 1-12.

Over the past few years, the Oregon Lidar Consortium has been working with various state and federal partners to enhance lidar coverage in Eastern Oregon. As of 2014, the OLC had acquired ten lidar collections covering over 3,500 square miles. An additional three OLC projects are currently being collected in portions of Baker, Grant, Harney, and Wheeler Counties.

Improving data collection and coordination should extend beyond state agencies. It should include a variety of partners—public and private—that share similar data needs related to water.

### A Strategic Enterprise Approach to Monitoring

Oregon's Stream Team was created in June 2013 and is made up of many of the state's natural resources agencies, all of which monitor Oregon's waters for various public purposes. State agencies that make up this team include:

- Department of Agriculture
- Department of Environmental Quality
- Department of Fish and Wildlife
- Department of Forestry
- Department of State Lands
- Oregon Health Authority
- Oregon State's Institute of Natural Resources
- Water Resources Department
- Watershed Enhancement Board

The Stream Team facilitates collaborative decision-making to support a healthy environment through coordinated planning, monitoring, and communication of water-related data and information. The work of the Stream Team directly supports the intent of the Integrated Water Resources Strategy, improving water resources data collection and monitoring by coordinating inter-agency efforts.

Thus far, the Stream Team has developed a collaborative workspace for agency partners and a monitoring calendar and associated map that are updated annually. Members meet regularly, where agencies provide input on statewide water-related monitoring issues, such as new stream gages, harmful algae bloom coordination, environmental data management strategies, and more.

The Stream Team is currently drafting an inter-agency statewide monitoring strategy and planning a "water monitoring summit" event for the North Coast basin in 2018. Various state and local entities will be invited to share recent monitoring-related work or priorities around water quality and quantity, surface water and groundwater, and fish and wildlife.

The North Coast Monitoring Summit was inspired by a similar gathering in 2013, organized by the Oregon Department of Environmental Quality and held in Northeast Oregon. More than 30 state and federal agencies, tribes, environmental organizations, businesses, and watershed councils participated, with several overlapping themes emerging from the summit.[8] Oregon DEQ and other entities can use events such as these to inform updates to monitoring priorities.

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

Examples of how to implement this action:

- Improve coordination of data sets
- Improve data availability using on-line platforms and emerging technologies, mobile apps, and open standards
- Develop or update modeling and other decision-support tools
- Encourage inter-agency work among a variety of partners

### Observations

Scientific information is a critical input into water-related decisions in both the public and private sectors. This chapter and the remaining chapters provide examples where this information is and should continue to be put to use.

## Recommended Actions at a Glance

| Critical Issue | Recommended Action |
|---|---|
| **Limited Water Supplies and Systems; Water Management Institutions; and, Water Quality & Quantity Information.** | **1.A Conduct Additional Groundwater Investigations**<br>**1.B Improve Water Resources Data Collection and Monitoring**<br>**1.C Coordinate Inter-Agency Data Collection, Processing, and Use in Decision-Making** |

# References

[1] U.S. Geological Survey. 1987. Average Annual Runoff in the United States, 1951-80. https://pubs.er.usgs.gov/publication/ha710

[2] U.S. Geological Survey. 2001. Groundwater Hydrology of the Upper Deschutes Basin, Oregon. Water-Resources Investigations Report 00-4162. https://pubs.usgs.gov/wri/wri004162/pdf/WRIR004162.pdf

[3] Oregon Water Resources Department. 2016. Water Resources Monitoring Strategy. Salem, Oregon. http://www.oregon.gov/owrd/LAW/docs/IWRS/MonitoringStrategy.pdf

[4] Oregon Water Resources Department, 2016. Water Rights in Oregon: An Introduction to Oregon's Water Laws. Salem, Oregon. http://www.oregon.gov/owrd/PUBS/docs/aquabook.pdf

[5] U.S. Environmental Protection Agency. 2016. Emergency Administrative Order, Safe Drinking Water Act, in the matter of the City of Flint Michigan. https://www.epa.gov/sites/production/files/2016-01/documents/1_21_sdwa_1431_emergency_admin_order_012116.pdf

[6] Oregon Department of Education. 2016. Healthy and Safety Schools Plan. Oregon Administrative Rules (OAR) 581-022-2223 http://www.ode.state.or.us/superintendent/priorities/1.-attachment-1---healthy-and-safe-schools-plan-oar-58-022-2223-8-15-16-final.pdf

[7] Oregon Water Resources Department. 2015. Mapping Oregon's Water-Related Institutions. Salem, Oregon. http://www.oregon.gov/owrd/LAW/docs/IWRS/Program_Mapping_January_2015.docx

[8] Borisenko, Aaron; Oregon Department of Environmental Quality. 2012. Oregon DEQ's 2012 Monitoring Summit: Why did we do it and what did we learn? Presentation to the National Water Quality Monitoring Council. https://acwi.gov/monitoring/webinars/webinar_OR-DEQ_Monitoring_Summits_11142012.pdf

# CHAPTER 2

## Understand Instream and Out-of-Stream Needs

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, recreation, and essential habitat for fish and wildlife.

A clean and reliable source of water is critical 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 environment 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.

Oregon continues to seek better information about 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.

**Quick Links to Main Sections:**

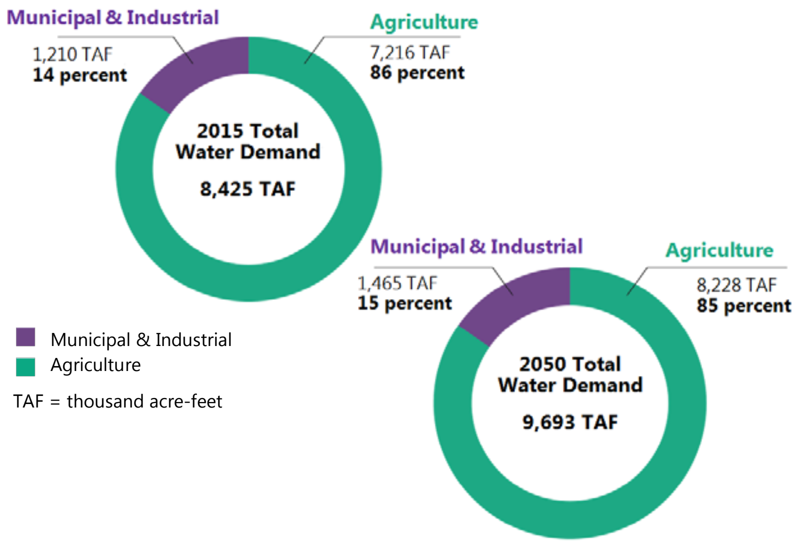
# Critical Issue – Further Define Out-of-Stream Needs / Demands

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 agriculture, municipal, industrial, and domestic purposes.

Uses that divert water are often considered a "consumptive" use. Today, water users in Oregon divert about 8.4 million acre-feet of water each year for out-of-stream uses, mostly during the spring and summer months when demand is at its highest. This annual volume of water demand represents approximately eight percent of the more than 100 million acre-feet of water that fills Oregon lakes, streams, and aquifers.[1]

Oregon's 2015 Long-Term Water Demand Forecast[2] describes potential long-term consumptive use demands in an Oregon that may not be able to rely on historic patterns to predict future rainfall and snowpack.

**Figure 2-1: Forecasted Change in Consumptive Water Demand by 2050**




Some counties and basins may face important changes by 2050 because of growth in water demand. The total change in demand rests on numerous assumptions about the future, assumptions that communities, governments and private partners can address together.

The 2015 scenarios and assumptions include a projected increase in both population and a longer, warmer growing season, leading to more demand by agricultural, commercial, residential and industrial water uses in 2050. If future climate conditions are both hotter and drier, Oregon could be faced with a need for an additional 1.3 million acre-feet of water annually.

### Water Use in Agriculture

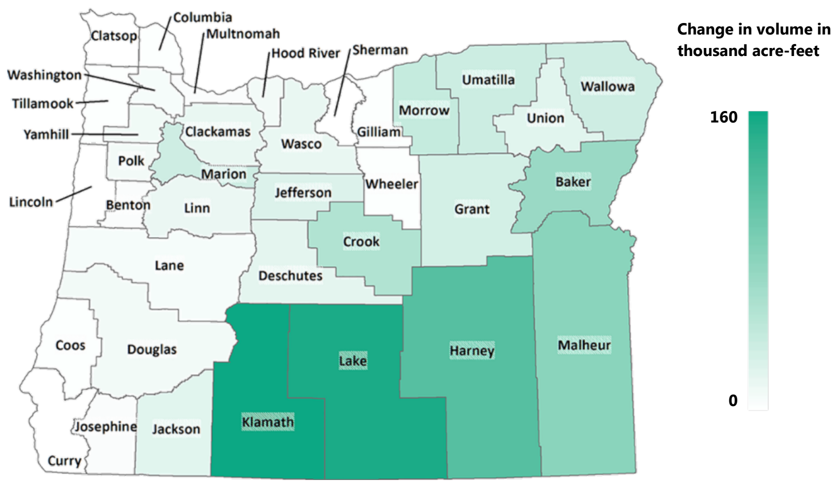
The majority of water used to grow crops comes from irrigation. The state's 2015 demand forecast indicated that irrigated agriculture uses an estimated 86 percent of the water that is diverted from surface water or pumped from groundwater sources.

Increases in agricultural water demand are expected from a range of possible changes in the climate resulting in prolonged agricultural growing seasons, increased day-to-day crop water consumption, and a larger annual water demand for sustaining Oregon's current agricultural lands.

Counties with the most <u>irrigated</u> acreage may experience the largest volumetric increase in agricultural water demand by 2050. The five counties with the highest projected <u>volume</u> increase in agricultural demand account for 45 percent of the irrigated acreage in Oregon today, and are: (1) Klamath, (2) Lake, (3) Harney, (4) Malheur, and (5) Baker. Refer to Figure 2-2.

[Note: deleted statistic on percent increases to avoid confusion to reader.] Because of higher demands for water, some areas of the state may also have to adjust how they meet those demands. Oregon's northwest counties have traditionally relied more heavily on precipitation than irrigation. Although total annual precipitation is likely to stay the same, it may be less available in the summertime to water crops. Irrigation may play a more important role in the future.

**Figure 2-1: Forecasted Change in Agricultural Water Demand by 2050**




**Contributions of Irrigated Agriculture**
Oregon agriculture provides a bounty of food and fiber products that are sold and consumed in Oregon and around the world. Yields of crops, including grains, can increase up to 500 percent, if irrigated. The Oregon Board of Agriculture 2017 industry report notes that 40 percent of Oregon's farms rely on some level of irrigation. The Board further notes that without safe, adequate supplies of water, Oregon's agricultural sector would look very different than it does today, both in terms of what can be produced in the state and as an economic contributor[3]

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 supports one of Oregon's highest ranking commodities – cattle and calves – valued at $914 million in 2015. Without water, none of this is possible.

Irrigated agriculture contributes significantly to the economy, food supply, and to local communities. The Department of Agriculture reports that Oregon's almost 35,000 farms produced more than 220 different products in 2015.[4] Oregon State University Extension calculated the state's 2015 agricultural production at $5.7 billion, making it a top economic driver in Oregon.[5] 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. In Oregon, irrigation with its related water rights more than doubles the value of crop land, from $1,950 per acre to $4,360 per acre, according to Oregon Agripedia.[6] Oregon State University Extension attributes 14 percent of Oregon jobs to agriculture, as well as $23 billion—or 11 percent—of the state's economy.[7]

The contribution of agriculture to Oregon's environmental health is also significant. Many agricultural fields serve as viewsheds 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.

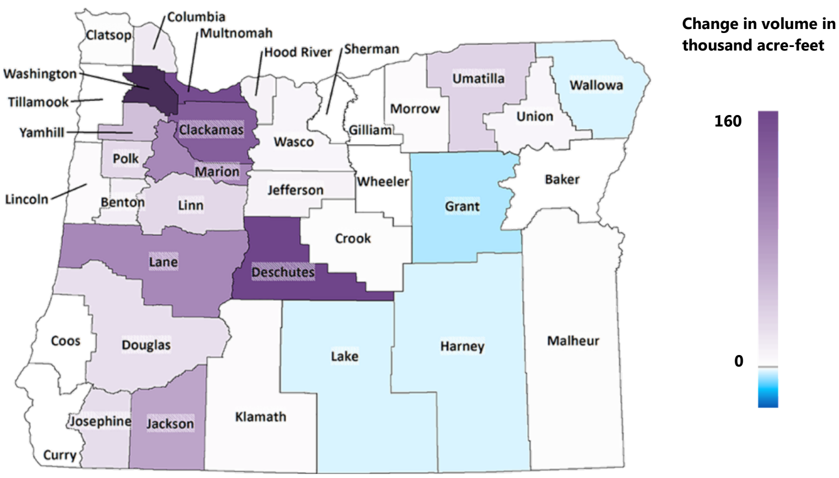
**Food Processing —** Oregon hosts hundreds of food manufacturing companies that play an essential part in food production by cooking, freezing, and packaging products for consumers. The food processing industry handles crops from cherries to onions and includes bakery and dairy products, fruits and 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.

## Municipal and Industrial Water Use

Municipal and industrial (M&I) demands, which collectively includes municipal service use, industrial use, water use in unincorporated areas, and self-supplied industrial use, accounts for approximately 14 percent of out-of-stream demands today.

Municipal service use, on its own, accounts for slightly less than 6 percent, or 490,000 acre-feet, of consumptive water demands today. 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.

**Figure 2-2: Forecasted Change in Municipal and Industrial Water Demand bv 2050**




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 residences, schools, parks, hospitals, industries, businesses, and other public and private facilities. In the past decade, manufacturing has largely been located in urbanized areas where access to a public water system has played an important role. The ability of municipal water systems to deliver reliable, high quality water supplies is one factor that has attracted industry to Oregon.

In the 2015 *Long-Term Water Demand Forecast*, M&I demands are anticipated to increase by 20 percent by 2050, resulting primarily from a projected 40 percent increase in population, or another 1.5 million residents.[8] Ongoing and planned conservation measures are expected to help temper water demand for many communities. However, the weighted average per capita M&I water demand for Oregon is projected to remain about the same as current conditions, increasing approximately 0.7 percent. Industrial and commercial demands served by municipal water systems are included in the projection of per capita demand. Most population growth is forecasted to occur in Oregon's large urban areas, with central Oregon projecting the highest percentage growth through 2050. Conversely, rural and unincorporated areas are expected either to remain stable in population or to experience some decline.

The counties with the highest projected volumetric increase in M&I water demand by 2050 are: (1) Washington, (2) Deschutes, (3) Multnomah, (4) Clackamas, and (5) Lane. Refer to Figure 2-3. The M&I demands for some counties are forecasted to increase more than the statewide average of 20 percent. [Note: deleted statistic on percent increases to avoid confusion to reader.]

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

Today, municipalities forecast water and wastewater demands and provide services to all who locate within their service territory. They often estimate the growth that might occur five, ten, even 50 years into the future and must be ready to serve that need.

**Water Demands for Self-Supplied Industries –** Today, self-supplied industrial water use represents just above six percent of the water diverted in Oregon, or 534,000 acre-feet. These self-supplied industrial and commercial facilities 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.

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 or delivery of goods, services, or commodities, along with the use of water to construct, operate, or maintain a facility.

For self-supplied industrial demand, Multnomah, Lane, Columbia, Clatsop, Clackamas, Marion, and Linn counties lead this category. Others with relatively large self-supplied industrial demands include Coos, Umatilla, Deschutes, and Douglas counties.

Self-supplied industrial demands served from separate and individual water rights are not projected to increase.

**Water Demands for Rural or Unincorporated Areas –** Municipal service or well water use outside of urban growth boundaries accounts for about two percent, or 187,000 acre-feet, of consumptive water demands in Oregon. This demand includes individual domestic well use. Although this amount of water is small in comparison to other out-of-stream demands, it represents an estimated 230,000 wells. The largest demands are in Washington, Clackamas, Deschutes, Jackson, and Josephine counties. These counties comprise more than 60 percent of water demands for unincorporated areas.

## Update the State's Long-Term Water Demand Forecast

The state should regularly update its fifty-year forecast of water needs across all sectors. Such a forecast includes identifying trends in water use, economic development, urban-rural population growth/shift, per capita demands, and changing crop water requirements due to a changing climate.

Additional forecasting is also necessary to determine instream flow needs. See Recommended Action 3.A for more details. Long-term water demand forecasting should be incorporated into place-based, integrated water resources planning efforts. For further discussion of place-based efforts, refer to Chapter 4.

As previously discussed, productivity of land and crop production can increase several-fold with the application of water. This expands the options of crops that can be grown, lowers the risk of impacts from harsh weather and disease, and generates additional revenues in the broader economy. Although the 2015 demand forecast held the mix of crops and the footprint of irrigated lands constant, in reality, planting and irrigation decisions will continue to change across the landscape, along with the climate.

As one example, wine grapes are a sensitive crop that may be affected by climate change. The regional climatic conditions that produce an optimum quality are considered to be narrow and differ for each varietal, ultimately putting wine grapes at a heightened risk to climatic variations and change. Research has shown that some of the gradual, historical shifts in the climate (1948 through 2002) have been beneficial to some wine grapes currently grown in Oregon.[9] However, the projected changes over the coming century may not continue to benefit wine grapes and could result in the migration of optimal conditions to more northerly regions that have traditionally been too cold for cultivation.[10] While these anticipated changes may occur over a period as long as 50 years, Oregon's wine grape growers have begun considering adjustments to watering practices, varietal choices, and locations of vineyards. These decision points will continue to be made across the agricultural sector in the coming years.

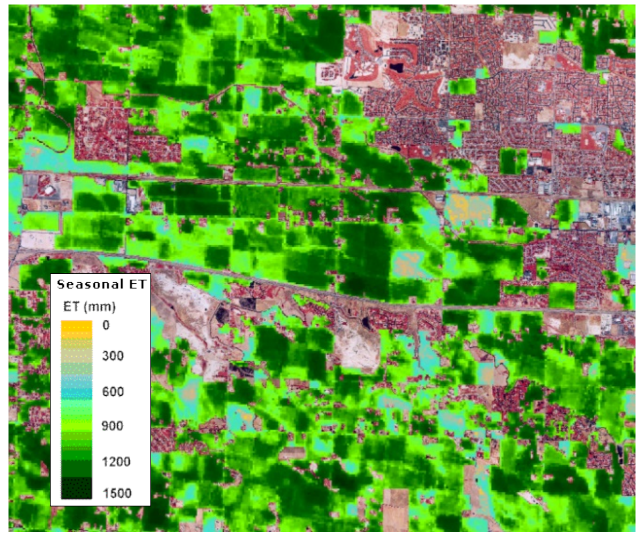
Quantifying and modeling the economic value of water (both instream and out-of-stream) will add to the value of such forecasts. For instance, the productivity of land increases several-fold with the application of water. This expands the options of crops that can be grown, lowers the risk of impacts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

### Expand the Use of Satellite Data

The use of evapotranspiration data developed from satellite imagery is an emerging measurement tool that helps us determine the location, timing, and quantity of agricultural water use.

Evapotranspiration (ET) is water that transpires from the leaves of plants and evaporates from soil. Calculating ET data can show the amount of water consumed by irrigated agriculture and by other lands. Figure 2-4 shows a sample satellite view at the field scale, although images can also be scaled to the county, basin, or state-level. Darker green areas connote higher ET; brown areas are not irrigated or non-crop areas.

**Figure 2-4: Sample Satellite View**




Remote sensing approaches transform thermal and reflected spectral imagery from Landsat satellite images into evapotranspiration images. The specific techniques used are referred to as METRIC (Mapping EvapoTranspiration at high Resolution using Internalized Calibration). METRIC is an energy balance model that computes and maps ET using Landsat images.

The METRIC approach provides 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.

Other states began using METRIC more than a decade ago. Idaho was a key partner in its development and has been using it ever since. The Desert Research Institute out of Nevada is in the process of modernizing methods of calculating ET from thermal and spectral imaging.

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

Examples of how to implement this action:

- Periodically update demand projections with new population, per capita water demand, industrial demand, crop water use, and climate projections
- Develop models/studies to quantify the economic, social, and cultural value of consumptive uses of water
- Employ remote sensing to improve crop water use estimates

Along with four other western states, Oregon is currently a co-investigator in a project sponsored by the National Aeronautics and Space Administration. Focusing first in the Greater Harney Valley, this project utilizes the METRIC approach with the added benefit of enabling end-users to readily access ET information for the region.

## Improve Water-Use Measurement and Reporting

Objective water management decisions are made possible when they are based on reliable information about water use. Availability of water use data is fundamental 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 models. Although the state has the authority to require users to measure water use, it does not have broad authority to compel reporting of the resulting data.

Water users who do keep track of their use are better able to demonstrate the validity of their water rights, to develop water management and conservation plans, and to determine the design and funding needs of their future water systems.

### Water-Use Measurement and Reporting Program

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. Approximately 17 percent of Oregon's water rights are required to report their water use to the state; this represents approximately 30 percent of the water that is authorized to be diverted. In 2013, the Oregon Legislature reinstated the position overseeing the state's Water-Use Reporting Program, as percent reporting to about 70 percent consistently today. In order to ensure continued effectiveness, funding for this program should be sustained.

In 2016, the U.S. Geological Survey awarded the state a grant to develop a workplan that identifies potential improvements to the Water-Use Reporting Program. The workplan sets forth a number of goals in the areas of data quality (improving the quantity, availability, reliability, and integrity of the water-use data) and accessibility for on-line users. Program staff are using the workplan to guide needed adjustments and make improvements over time. Exploring the use of emerging measurement tools could also help improve the accuracy of water use information.

### 2000 Strategic Measurement Plan

In 2000, the Water Resources Commission developed a strategic measurement plan focused on diversions of surface water with the greatest impact on streamflows in areas with the greatest needs for fish. A statewide inventory was conducted, helping to identify approximately 2,300 "significant diversions" within nearly 300 high priority watersheds across the state. The Commission updated the plan in 2007.

The Department's field personnel work with landowners to implement the Commission's *Strategic Measurement Plan*,[11] installing measurement devices (e.g., weirs, flumes, and meters) at these significant diversions. By the end of 2015, nearly 1,000 measurement devices had been installed. However, many of the inventoried diversions are no longer in use, and many of the diversions have no requirement to report on water use. The plan's focus on surface water left out an important measurement need: groundwater. Given that the program is 17 years old, the inventory and approach underpinning this program needs to be assessed and updated.

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

Examples of how to implement this action:

- Continue to improve the software and tools used for water-use measurement and reporting
- Improve the state's authority to require reporting of water use
- Update and implement the Water Resources Commission's Strategic Measurement Plan, measuring significant diversions
- Coordinate the Water-Use Reporting Program and Commission's Strategic Measurement Plan

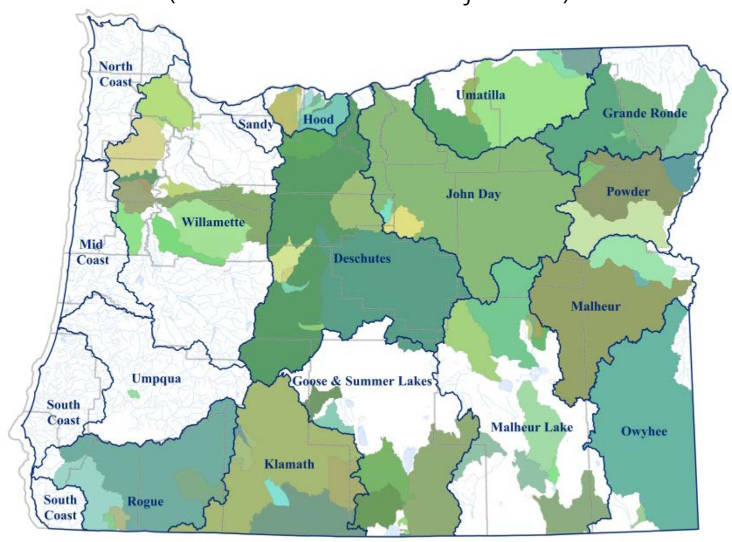
Cost-share dollars for measurement devices are critical to the program's success. The 2013 Oregon Legislature placed funding for this cost-share program into the Water Resources Department's base budget so that it could partner with water users in these efforts. The 2017 Oregon Legislature expanded the cost-share program to include groundwater withdrawals.

## Determine Unadjudicated Water Right Claims

In many parts of Oregon, landowners began using water long before the Oregon Water Code was enacted. Passage of the Water Code by the Legislature in 1909 established, for the first time in Oregon, a centralized administrative system for acquiring rights to the use of surface water. These water rights are managed within a prior appropriation system of water allocation.

Claims to the use of surface water that predate the Oregon Water Code are required to go through a formal administrative judicial process known as an adjudication, to have their water right claims quantified, documented, and eventually incorporated into the prior appropriation system. Although not discussed in detail here, there are similar procedures for conducting adjudications for groundwater uses that pre-date the Department's authority to issue groundwater rights.

**Figure 2-5: Status of Surface Water Adjudications**
(colored areas have been adjudicated)




The ability to manage water resources has been greatly facilitated in those areas of the state where adjudications have been concluded. Adjudicating water right claims creates an enforceable system that is protective of senior users in times of shortage. Without the adjudication process, these claims cannot make calls for their water or take advantage of water management tools, such as transfers or leases.

The state's most recent adjudication proceeding started back in 1975 in the Klamath River Basin. In 2013, the state completed the administrative phase of the Klamath Basin Adjudication. The Klamath County Circuit Court is now assessing the Amended and Corrected Findings of Fact and Order of Determination (ACFFOD). Adjudication claimants or contestants who dispute the Department's determinations had an opportunity to file exceptions with the Klamath County Circuit Court. After review, the Court will issue a water rights decree, either affirming or modifying the ACFFOD. The Water Resources Department can then issue water right certificates in accordance with the decree.

The remaining unadjudicated areas for surface water, shown in white in Figure 2-5, consist primarily of river basins located west of the Cascades. In some instances, federal reserved rights, including tribal claims, still have not been determined in basins that have been adjudicated. Tribes play an important role in the resolution of water rights claims in basins throughout the West. The need to resolve tribal and federal rights in Oregon is real and significant.

**Recommended Action 2.C**
**Determine Unadjudicated Water Right Claims**

Examples of how to implement this action:

- Conduct surface water and groundwater adjudications
- Settle federal reserved claims, including tribal claims

Future tasks include conducting adjudications where needed to resolve surface water and groundwater claims. Additionally, there is a need to determine federal reserved rights, including tribal rights, which may be resolved as part of an adjudication or through a settlement.

## Update Water Right Records

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 land with its appurtenant water rights. More than 74,000 certificates are held by water users. The state needs the ability to respond to holders of water rights who are asking to modify the names on these certificates. Having this authority will enable the state to update ownership information in its records.

This authority will also help facilitate Water Resources Department processes, such as communicating with water right holders, researching water rights, mapping water rights with geographic information systems (GIS), updating the water rights database, and improving compliance with measurement and reporting conditions.

A legislative concept was introduced during the 2013 Legislative Session to authorize such updates. The bill did not move out of committee.

**Recommended Action 2.D**
**Authorize the Update of Water Right Records with Contact Information**

Examples of how to implement this action:

- Authorize the Water Resources Department to update names on water right certificates
- Update related water right records, including databases and geographic information system (GIS) layers

## Oregon's Water-Related Permitting Guide

In Oregon, protecting our natural and cultural resources and the benefits they provide 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 natural resources agencies to ensure that water quality, ecological needs, and land use goals and requirements are integrated into the decision-making process. The Water Resources Department acts as the lead in this process, soliciting comments from other agencies and the public, and placing conditions on 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. Some new groundwater uses require mitigation.

In 2013, the Oregon Department of State Lands revised its Water-Related Permitting Guide[12] for the regulatory and nonregulatory programs that influence the permitting of projects in wetlands and waterways. Updating the permitting guide has been done with existing resources, as time allows. Oregon's permitting guide contains contact information, web links to application forms, review standards, and references to applicable rules. This information changes and should be updated on a regular basis.

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

Examples of how to implement this action:

- Provide updated agency contacts, policies, and links
- Provide industry-specific information, where possible

The next edition of the permitting guide could be updated to reflect new or emerging industries. The revised guide could also take the form of a one-stop shop document, and include any administrative instructions to guide application reviewers, sister agencies, and the public. An accompanying online application portal that could accept all water-related permits more efficiently is a request that agencies often hear.

# Critical Issue – Further Define Instream Needs / Demands

The water that is not diverted during the course of the year supports a variety of instream needs. A portion of this water, approximately 19 million acre-feet, is protected by more than 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 transportation, recreation, tourism, and fishing.

Oregon's water resources serve as scenic attractions and directly support the habitat needed for species to live and thrive. Our rivers and streams, lakes, reservoirs, aquifers, wetlands and estuaries all contribute greatly to our economy and health. Without adequate water within the system, instream uses and their associated economic and ecological benefits are threatened and may be degraded.

## Water Instream Supports Economic Health

Instream flows have helped with society's economic development needs, from navigation and transportation of goods, to recreation and fishing—both for sport and for commercial purposes. A number of recent reports and studies are able to help quantify these benefits.

### Navigation

The state's waterways have long served as important routes for travel and trade. According to the American Society of Civil Engineers (ASCE),[13] Oregon boasts 680 miles of inland waterways, ranking 15th nationally. ASCE further calculates that 32.1 million short tons of cargo moved through Oregon in 2014, ranking Oregon 25th in the nation. Many of the agricultural products grown in Oregon and elsewhere in the United States move down the Columbia River by barge. Instream flows facilitate ocean-going and river-going commerce, and promote economic activity at ports and cities throughout Oregon. During 2015, the Port of Portland[14] was home to 400 companies. The Port provided 700 marine-related jobs and brought $629 million to the region through its marine-related activities.

### Water-Related Recreation and Tourism

The focal point of many recreational activities in Oregon is often a river, waterfall, lake, wetland, or 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. In a 2011-12 survey, the Outdoor Industry Association[15] estimated that all outdoor recreation in Oregon generates $12.8 billion annually in consumer spending, and supports 141,000 direct jobs—$4 billion in wages and salaries. These numbers are roughly similar to statistics in Nevada, Utah, Colorado, and Arizona, but far below those in Washington and California.

According to the most recent national survey by the U.S. Fish and Wildlife Service,[16] 1.8 million Oregonians and nonresidents (16 years old and older) fished, hunted, or watched wildlife in Oregon in 2011. This group spent $2.7 billion on hunting, fishing, and wildlife-related recreation in the state over the same time period. Many of Oregon's counties, such as Harney, Lake, Morrow, and Wheeler, 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 water instream for the benefit of future generations.

Many of the state's day-use parks and overnight camping facilities reside along 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. Each year, these facilities[17] host an estimated 46 million daytime visitors (4th in the nation), and 2.5 million campers (8th in the nation).

Boating and kayaking are popular recreational activities as well, with more than 168,000 recreational boats in the state.[18] There were nearly 2.2 million boat-use days in Oregon during the 2013 boating season, according to the Oregon State Marine Board's triennial survey[19]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 were the most popular rivers, and Lake Billy Chinook, Brownlee Reservoir, Detroit Lake, Wallowa Lake, Prineville Reservoir, and Diamond Lake were the most visited lakes and reservoirs.

### 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,[20] in 2011, there were about 5.2 million fishing days spent by Oregon residents and non-resident freshwater anglers and more than 600,000 fishing days spent by resident and non-resident saltwater anglers. In 2011, the economic impact of sport fishing in Oregon, in both freshwater and saltwater environments, totaled more than $680 million in retail sales, supporting more than 11,000 related jobs in Oregon, and generating an economic output nearly 1.2 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 the commercial fishing industry,[21] more than 210 million pounds of fish were delivered to Oregon ports in 2015. The harvest value of onshore landings was $136.2 million. The estimated total personal income generated by Oregon's commercial fishing industry (onshore and distant water fisheries) in 2015 was $489 million. The Dungeness crab fishery typically dominates the commercial fishing industry, accounting for about one-third of the state's onshore landing harvest value for the 2010-14 period. Commercial fisheries support thousands of jobs and a number of communities along the Oregon Coast, providing up to a third of the annual earned income in some towns. A healthy fishery can support a cluster of fish processing plants, mechanics, machine shops and welders, refrigeration specialists, marine electronics sales and service firms, boat yards, 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.

### Hatcheries

The Oregon Department of Fish and Wildlife operates more than 30 hatcheries and several rearing ponds statewide. These facilities raise salmon, steelhead, and several species of trout. Hatcheries play a vital role in the state's overall efforts to maintain healthy fish populations and supplement recreational and commercial harvests. Each year, the state raises and releases more than 50 million fish from hatcheries. Clean, cold water is critical for the proper functioning of these facilities.

## Water Instream Supports Ecosystem Health

Along with supporting the economy, water is needed within the environment to ensure overall ecosystem health. Streamflow from rainfall and snowmelt sustains aquatic and terrestrial life. Springs, rivers, lakes, and wetlands are also dependent on the discharge of groundwater to the surface. Other ecosystems such as riparian areas, some forests, 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 when the current is swift. The complexity of the habitat directly contributes to the health and function of fish-bearing streams.

In 2015, the Oregon Department of Environmental Quality, U.S. Environmental Protection Agency, and the National Oceanic and Atmospheric Administration announced a partnership under the Clean Water Act to locate, protect and restore zones of cold water habitat for fish in the Columbia and lower Willamette Rivers.[22] Salmon and steelhead need "cold water refugia" during their migrations upstream on the way to spawn. Such safe havens play an important role in the survival and migration of adult salmon and steelhead as rivers warm during the summer.

## Determine the Flows Needed to Support Instream Needs

A healthy stream experiences base flows as well as a variety of elevated flows that provide habitat maintenance and other ecosystem functions. This section looks at next steps for understanding base and elevated streamflows and for assessing groundwater-dependent ecosystems.

### Instream Needs

Instream flow provides habitat for native fish, which have a high economic and social value in Oregon. The ability to meet instream needs is limited by our understanding of instream flows.

While scientists know that a wide variety of ecosystems and species depend upon a spectrum of flows (frequency, magnitude, and timing), it is difficult to quantify those needs precisely. It is also difficult to predict the degree of ecological degradation that occurs with differing qualities and quantities of water.

The Oregon Department of Fish and Wildlife, Department of Environmental Quality, and Parks and Recreation Department are authorized to apply for instream water rights for specific purposes, such as the protection of fish habitat, water quality, and scenic values. Such applications require scientific analysis and modeling to determine the base flows needed to meet the physical habitat requirements of target species and life stages. Certificated instream water rights come with legal status and protections under the prior appropriation system.

In general, the state has very little capacity to monitor whether all instream water rights are being met. There are more than 1,400 instream water rights in place, whereas, the state only has stream gages in place to monitor 205 of them. To fill this gap, the Water Resources Department's field personnel often take additional streamflow measurements in locations that are not monitored with permanent equipment.

The Department of Fish and Wildlife's flow recommendations reflect the best available information on the biological requirements of fish present. As such, instream water rights can be used to set goals for flow restoration for fish, wildlife, and their habitats. To date, agencies have established instream water rights to protect minimum flows and they focus almost exclusively on depth, velocity, and substrate criteria.

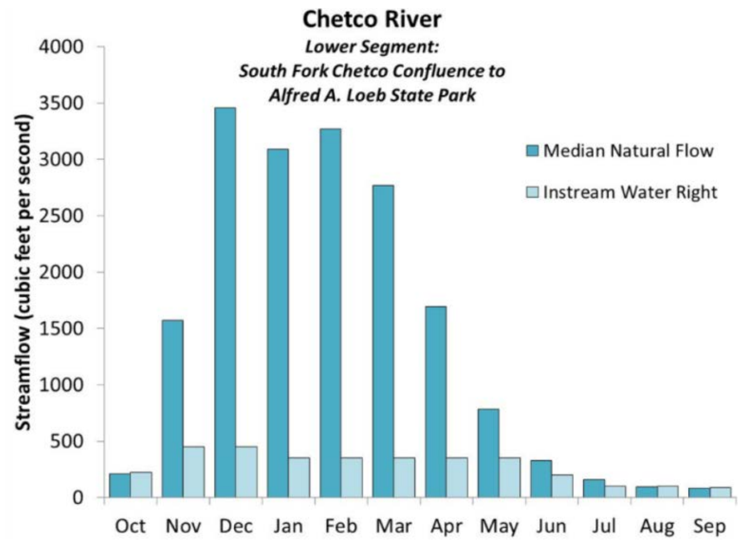
As demonstrated in the sample bar graph, instream water rights held by agencies are relatively consistent throughout the year, as they have been designed to protect the physical habitat requirements for rearing, spawning, and other life stages.

Today's instream water rights typically do not follow the shape of the hydrograph during the course of the year and are not protective of the elevated flows that provide benefit to the overall ecosystem.

Some protections do extend to ecological-elevated flows, such as the determined claims held by The Klamath Tribes. Holding the most senior priority dates in the Klamath Basin, the Klamath Tribes have the ability to support riparian and geomorphic functions during periods of high flow.

There are other mechanisms that can be used to protect water instream, such as water leases and transfers. Additional discussion about these tools can be found in Chapter 4.

**Figure 2-3: Comparison of Streamflow to an Instream Water Right**




## Understand Ecological Base Flows and Ecological-Elevated Flows

Flow functions are often grouped into the following categories:

**Ecological Base Flows –** Ecological base flows discussed here are different from the hydrologic use of the term base flow—which describes the contribution of groundwater to streams, a primary source of water during dry summers. Ecological base flows are established as a lower protective threshold to provide physical habitat space for fish and other aquatic organisms. Ecological base flows are defined in order to be sufficient in flow for incubation, rearing, and spawning for key species over long periods of time. While there is information about base flow needs for the high-profile salmonid species, there is less information about base flow needs for other species including lamprey, chub, white fish, other native fish species, amphibians, or macroinvertebrates.

The Department of Fish and Wildlife conducted base flow studies even prior to adoption of the 2012 Strategy, as time and resources allowed. In preparing new instream water rights, the state identified streams with completed studies, and will prioritize and complete new studies and those that require updates. The 2015 Legislature authorized and funded limited duration biologists to conduct studies, which are currently underway based on a prioritized selection of areas and/or stream reaches. The Department of Fish and Wildlife will need consistent resources to pursue its instream work objectives.

**Ecological-Elevated Flows –** These flows are a subset of instream flows that are directly related to the ecology of the stream system. They include biological triggering flows that may elicit 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 that rework the channel or streambed, rejuvenating or cleaning gravel, flushing sediment, reforming habitat features, replenishing or rejuvenating riparian vegetation, and/or re-establishing connectivity with off-channel habitats.

More information is needed with regard to ecological-elevated streamflows. The state can begin by developing criteria to determine the elevated flow needs in each water basin/watershed.

Some water projects using implementation funds from the state under Senate Bill 839 (2013)[23] will need flow prescriptions that describe the duration, timing, frequency, and volume of flows required to maintain the biological, ecological, and physical functions of the watershed. The first of those efforts began in 2017.

**Long-Term Instream Demand Forecast –** [note: new sub-title]. As discussed earlier, the state has completed two long-term demand studies that focused on forecasting consumptive demands for agricultural, municipal, domestic, and industrial uses. A parallel analysis for instream needs has not been completed. The state should conduct a long-term instream demand forecast study, characterizing the species, water quality, and water quantity needs by location.

The state is developing a study approach that considers watershed characteristics like temperature, discharge, land cover, precipitation, slope, and elevation. Climate projections will also be important to better understand how water quality and quantity could change in the future.

Combining this information with species distribution would allow comparison of current and potential streamflow (i.e., volume and timing) relative to the needs of fish species throughout their lifecycle. A study like this could examine locations where the volume of water rights outstrips streamflow during the summer months, signaling stream reaches that are potentially vulnerable during periods of drought.

Understanding when and where species may be vulnerable can inform streamflow and habitat restoration efforts and areas in need of additional study. The study could also identify where to establish future measurement sites or additional instream water rights. Lastly, such a study could help pinpoint where mitigation (actual water) is needed. Increasingly, entities applying for water rights are required to develop mitigate measures to minimize the effects of the proposed use on fish species.

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

Examples of how to implement this action:

- Prioritize and install gages in additional locations to monitor the status of instream flows and water rights
- Identify basins with listed species and install monitoring equipment to help characterize the suite of flows through these basins
- Conduct instream needs studies, such as base flow studies and elevated flow requirements or prescriptions
- Pursue a consistent, model-based framework for characterizing long-term instream demand and integrate projections of future climate for planning purposes
- Develop models/studies to quantify the economic, social, and cultural value of instream uses
- Support state agency instream flow efforts and programs (e.g., ODFW, ODEQ, OPRD)

**Highlight Box**

**Connecting Consumers to Salmon-Safe Products and Places**

"For us as brewers, we've been long-time supporters of Salmon-Safe and their work with hop growers to increase environmental sustainability," said Angela Jasus, field marketing manager at Deschutes Brewery. By sourcing Salmon-Safe hops, leading regional and national craft brewers are helping to transform growing practices to protect water quality and wildlife habitat in the Willamette and Yakima valleys, two key wild salmon watersheds that are the source of 90 percent of hops in the United States.

Salmon-Safe is also partnering with Mainstem Malt to certify dryland grain growers who are restoring streamflows and building high value markets for locally grown, locally processed malt that's provided to brewers and bakers. This has led to the first fully certified Salmon-Safe beers on the market – the entire supply chain is certified safe for salmon.

Nearly two decades after first certifying farms and vineyards in the southern Willamette Valley, Salmon-Safe has transitioned more than 400 Oregon farms, including the state's leading hop growers and nearly a third of Oregon's vineyard acreage to Salmon-Safe practices that protect fish and wildlife. This "eco-label" can help consumers find products in the marketplace that benefit watersheds and salmon.

Salmon-Safe also works within the urban environment to help implement environmentally innovative site development and best management practices that benefit the watershed. The City of Portland recently became the first Salmon-Safe city after a comprehensive, three-year assessment of its planning, facilities, and operational practices at hundreds of sites across the city.

"Portland is a city of rivers, and our economic wellbeing and quality of life rise with the health of the Willamette and Columbia, our many creeks and our native endangered salmon. I am proud to leave a Salmon-Safe legacy that is now embedded in city operations."

- Charlie Hales, Mayor of Portland, October 2016

Find more information at: http://www.salmonsafe.org/.

## Assess Groundwater-Dependent Ecosystems

Groundwater is a vital source of water that sustains both ecosystems and human communities. 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 species native only to these locations. Throughout the U.S., The Nature Conservancy has found that 17 percent of species—invertebrates, vertebrates, vascular plants, and lichen—on the federal Endangered Species List are dependent on groundwater for their persistence.[24]

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.[25] Rivers such as the Williamson in the Klamath Basin or Metolius in the Deschutes have high hydrological base flow through the summer—contributed to by groundwater—and they support important populations of cold water fish species. Plants such as bladderworts and sundew, amphibians including Oregon spotted frogs and Northwest salamanders, and fish such as Bull trout all rely on a perennial source of water.

Some organizations have already taken steps toward protecting groundwater-dependent ecosystems like these. The Nature Conservancy assisted the U.S. Forest Service in developing a series of protocols for inventorying and monitoring groundwater-dependent ecosystems.[26] Using these methods, the Conservancy, in collaboration with the U.S. Geological Survey, identified 67 peat-forming groundwater-dependent wetlands known as fens in the Upper Deschutes Basin.[27] In the more arid Crooked Basin, these same researchers inventoried nearly 200 springs, which they found to be most likely connected to shallow, low discharge flow systems that are highly susceptible to climate warming.[28]

Groundwater-dependent ecosystems still need to be fully identified and characterized across the state. 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 help meet the needs of people, species, and ecosystems. For example, in the Oregon Dunes National Recreation Area, municipal wells pump water from an unconfined sand dune aquifer that also supports two sensitive species of amphibian that breed in the swale wetlands. By quantifying the groundwater needs of amphibians and wetland plants, compatible pumping levels supportive of wetland species were identified.[29]

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

Examples of how to implement this action:

- Identify and characterize groundwater-dependent ecosystems
- Quantify the water quantity and water quality needs of groundwater-dependent ecosystems

## Recommended Actions at a Glance

| Critical Issue | Recommended Action |
| --- | --- |
| Out-of-Stream Needs/Demands | **2.A Regularly Update Long-Term Water Demand Forecasts**<br>**2.B Improve Water-Use Measurement and Reporting**<br>**2.C Determine Unadjudicated Water Right Claims**<br>**2.D Authorize the Update of Water Right Records with Contact Information**<br>**2.E Regularly Update Oregon's Water-Related Permitting Guide** |
| Instream Needs / Demands | **3.A Determine Flows Needed (Quality and Quantity) to Support Instream Needs**<br>**3.B Determine Needs of Groundwater-Dependent Ecosystems** |

## References


[1] U.S. Geological Survey. 1987. Average Annual Runoff in the United States, 1951-80 https://pubs.er.usgs.gov/publication/ha710

[2] Oregon Water Resources Department. 2015. Statewide Long-Term Water Demand Forecast. Salem, Oregon. http://www.oregon.gov/owrd/LAW/docs/IWRS/OWRD_2015_ Statewide_LongTerm_Water_Demand_Forecast.pdf

[3] Oregon Board of Agriculture. 2017. State of Oregon Agriculture Industry Report. http://www.oregon.gov/ODA/shared/Documents/Publications/Administration/BoardReport.pdf

[4] Oregon Department of Agriculture. 2016. Oregon Agriculture Facts and Figures. http://www.oregon.gov/ODA/shared/Documents/Publications/Administration/ORAgFactsFigures.pdf

[5] Oregon State University Extension Service Rural Studies Program. 2015. Oregon Agriculture, Food and Fiber: An Economic Analysis. Salem, Oregon. http://agsci.oregonstate.edu/sites/agsci.oregonstate.edu/files/oregon_agriculture_2015.pdf

[6] Oregon Department of Agriculture. 2016. Oregon Agripedia 2015. Salem, Oregon. https://www.oregon.gov/ODA/shared/Documents/Publications/Administration/Agripedia.pdf

[7] Oregon State University Extension Service Rural Studies Program. 2015. Oregon Agriculture, Food and Fiber: An Economic Analysis. Salem, Oregon. http://agsci.oregonstate.edu/sites/agsci.oregonstate.edu/files/oregon_agriculture_2015.pdf

[8] PSU-PRC (Portland State University Population Research Center). 2015. Coordinated Population Forecasts for Region 1. Portland, Oregon. http://www.pdx.edu/prc/region-1-documents

[9] Jones, G. V. 2005. Climate Change in the Western United States Grape Growing Regions. Acta Hortaculturae. (ISHS). 680:41-60. http://www.sou.edu/assets/envirostudies/gjones_docs/GJones-ActaHorticulturae05.pdf

[10] Campbell, W.D. 2013. Spatial Analysis of Climate and Winegrape Production in Winegrape Growing Regions of Oregon. Dissertations and Theses. Paper 1442.

[11] Oregon Water Resources Department. 2007. Strategic Measurement Plan Update. Salem, Oregon. https://www.oregon.gov/owrd/docs/reports/priority_wab_report03-2007.pdf

[12] Oregon Department of State Lands. 2012. State Water-Related Permits Guide. Salem, Oregon. http://www.oregon.gov/dsl/WW/Documents/water_related_permits_user_guide_2012.pdf

[13] American Society of Civil Engineers. 2017. Infrastructure Report Card: Oregon Infrastructure Overview. http://www.infrastructurereportcard.org/state-item/oregon/

[14] Port of Portland. 2017. Fast Facts: Our Role in the Region We Serve. Portland, Oregon. http://www2.portofportland.com/Inside/FastFacts

[15] Outdoor Industry Association. 2012. Oregon Outdoor Recreation Economy Report. https://outdoorindustry.org/images/ore_reports/OR-oregon-outdoorrecreationeconomy-oia.pdf

[16] U.S. Fish and Wildlife Service. 2016. National Survey of Fishing, Hunting, and Wildlife-Associated Recreation.

[17] Oregon Parks and Recreation Department. 2017. *News Media Webpage*. Salem, Oregon. http://oregonstateparks.org/index.cfm?do=v.dsp_news

[18] National Marine Manufacturers Association. 2015. Economic Significance of Recreational Boating in Oregon. www.nmma.org

[19] Lesser, V.M., L. Newton, and A. James. 2014. Boating in Oregon: Results of the 2014 Triennial Boating Survey. Conducted for the Oregon Marine Board. Salem, Oregon.

[20] American Sportfishing Association. 2013. Sportfishing in America. http://asafishing.org/uploads/2011_ASASportfishing_in_America_Report_January_2013.pdf

[21] Oregon Department of Fish and Wildlife. 2016. Oregon Commercial Fishing Industry in 2015: Briefing Report. Salem, Oregon. http://www.dfw.state.or.us/agency/docs/OR%20Comm%20Fish%20Ec%20Impacts%20Brief%202015.pdf

[22] U.S. Environmental Protection Agency. 2015. State, Federal Agencies to Map and Protect Cold Water Refuges for Fish in Columbia and Willamette. Seattle, Washington.

[23] Oregon Legislature. 2013. Senate Bill 839. Salem, Oregon. https://olis.leg.state.or.us/liz/2013R1/Downloads/MeasureDocument/SB839

[24] Blevins, E. and A. Aldous. 2011. Biodiversity Value of Groundwater-Dependent Ecosystems. *Wetland Science and Practice*. 28:18-24. https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/oregon/freshwater/Documents/GW_Blevins%20and%20Aldous_2011_WSP.pdf

[25] Stevens, L. & V. Merestsky. 2008. Aridland Springs in North America: Ecology and Conservation. University of Arizona Press. Tucson, Arizona.

[26] U.S. Forest Service. 2012. Groundwater-Dependent Ecosystems: Levels I and II Inventory Field Guide. General Technical Report WO-86b. Washington, D.C.

[27] Aldous, A.R., M.W. Gannett, M. Keith, and J. O'Connor. 2015. Geologic and Geomorphic Controls on the Occurrence of Fens in the Oregon Cascades and Implications for Vulnerability and Conservation. Wetlands. 35(4): 757-767.

[28] Aldous, A.R., M.W. Gannett, M. Keith and J.O'Connor. The Nature Conservancy and U.S. Geological Survey, unpublished data.

[29] Aldous, A.R., R. Congdon, E. Blevins, J. Christy, Z. Freed, J. Gurrieri, L. Bach, and T. Carroll. 2017. Environmental Flows and Levels for Groundwater-Dependent Ecosystems of the Oregon Dunes National Recreation Area of the Siuslaw National Forest.

# CHAPTER 3

## Understand the Coming Pressures that Affect Our Needs and Supplies

Oregon must plan and prepare for some of the most powerful changes—such as multi-year droughts—that will continue to affect both water resources and water needs into the future. When the Integrated Water Resources Strategy was first adopted in 2012, this section on "coming pressures" felt like the topics were in the distant future. The future arrived quickly, and we find ourselves facing pressures in 2017 that are urgent and real.

Oregon Revised Statute 536.220 specifies that the Integrated Water Resources Strategy must take into account climate change, land-use change, and population growth. The Governor has also identified climate change and drought as realities for which Oregon needs to build resiliency. Preparing for extreme events, such as droughts, floods, and earthquakes are new editions to the 2017 Strategy.

This chapter addresses these issues, as well as the connection between energy and water, the intersection of water and land use, and the need to maintain, upgrade and modernize our water and wastewater infrastructure. Finally, education and outreach is another critical issue to consider as industry leaders retire and new leaders emerge. Education and outreach audiences range from school children to water professionals and the public at large.

**Quick Links to Main Sections:**

# Critical Issue – Water and Energy

The 2017 Integrated Water Resources Strategy focuses on the link between water and energy, as the two are highly interdependent. Water is used for producing electricity in Oregon. At the same time, a tremendous amount of energy is used to deliver water to where it is needed.

## Energy-Water Interdependence

Any consideration of the water-energy nexus must include an evaluation of how energy is used in water services and water is used in energy production. Although the U.S. Department of Energy released a 2014 Report examining the water-energy nexus, this topic is still largely unaddressed in water policy, studies, or planning activities in Oregon.[1] The following discussion demonstrates where more attention and analysis is needed.

### Water Needs in the Energy Industry

Water is critical for electric production. The U.S. Department of Energy estimates that nearly half of all water withdrawn in the United States is used at thermal electric power plants.

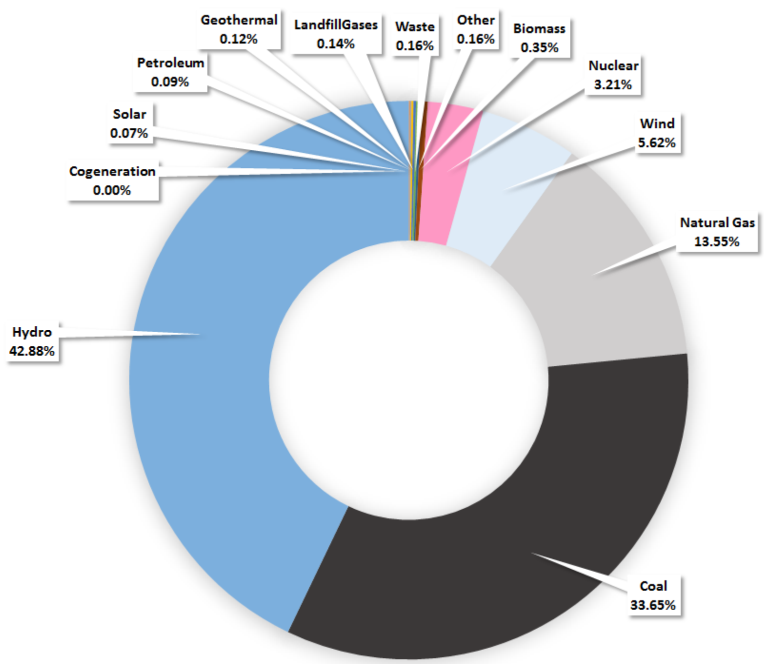
In Oregon, the electricity we use comes from energy production plants throughout the West, including hydroelectric, coal, natural gas, wind, solar, and other sources (see Figure 3-1).

About 40 percent of the electricity used in Oregon is generated by hydroelectric facilities.

The Northwest Power and Conservation Council's *Seventh Power Plan*,[2] adopted February 2016, suggests that future growth can be best served by energy conservation, followed by renewable energy.

Solar and wind facilities are the primary projects currently proposed and under construction in Oregon.[3]

**Figure 3-1: Sources of Electricity Used in Oregon**




Oregon's 2016 Renewable Portfolio Standard revision requires that 50 percent of the electricity sold by Oregon's large utilities comes from renewable resources by 2040. As the state pursues its long-term climate goals and accelerates the deployment of renewable energy resources to meet the 50 percent requirement, the state will need a better understanding of how those goals will affect water resources. Wind and solar generation facilities have minimal water needs, but new thermoelectric generation may be added to supply electricity when wind and solar are not meeting demands. Energy storage advancements could reduce the need for new thermoelectric generation.

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.

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

Examples of how to implement this action:

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

## Expand Oregon's Non-Traditional Hydroelectric Portfolio

Non-traditional hydroelectric projects will likely be part of new resources developed under the state's Renewable Portfolio Standard. According to the *Seventh Power Plan*, the most promising new generation in the hydropower sector will come from pumped storage, the addition of power facilities on existing dams, and the addition of power within existing irrigation systems. The *Plan* describes 388 megawatts (MW) of potential new capacity from efficiency upgrades at existing hydro facilities in the Pacific Northwest and up to 2,640 MW of capacity from new pumped storage facilities.

### Pumped Storage Systems

A pumped storage system consists of two reservoirs, one at a higher elevation than the other, where water moves from the upper reservoir to the lower reservoir to generate power when demand is high. Water is then pumped back up to the higher reservoir, using electricity, when electricity pricing and demand is low, usually at night. Pumped storage systems can be considered both a power management tool and an energy storage device. Currently, there are two proposals for pumped storage projects in central Oregon near Prineville and a project north of Klamath Falls. Neither proposal has been licensed or constructed yet.

### Conduit Hydroelectric Development

The Northwest Power and Conservation Council's Columbia River Basin Fish and Wildlife Program has designated certain river reaches as "protected areas," finding that new hydropower development in those areas would have unacceptable risks of loss to fish and wildlife.[4] Exemptions to this policy include adding hydroelectric facilities to already-existing non-hydroelectric dams or diversion structures.

Oregon has an expedited review process for proposed new hydroelectric projects at existing artificial delivery systems. The amount and timing of water diverted for an existing water use must remain unchanged (Oregon Revised Statutes 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 rights certificate will include requirements for fish screens, by-pass devices, and fish passage, with some exceptions.

In 2013, the Oregon Legislature passed Senate Bill 837, giving in-conduit hydro developers a choice: install fish passage as required by the Oregon Department of Fish and Wildlife or pay into a statewide fish passage account that will fund fish passage at priority locations identified by Fish and Wildlife.[5] The bill requires a review of this funding mechanism by October 1, 2018.

There are other projects generating electricity as water is injected into aquifer storage and recovery wells. Installed before the in-conduit rules described above, aquifer storage and recovery projects at Madison Farms of Echo and the City of Pendleton also represent a non-traditional use of hydroelectric power.

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

**Recommended Action 4.B**
**Take Advantage of Existing Infrastructure to Develop Non-Traditional Hydroelectric Power**

Examples of how to implement this action:

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

## Gain Water and Energy Savings

There are many options when selecting energy-efficiency and water efficiency techniques. Significant efficiencies could be realized from coordinating energy conservation and water conservation efforts.

### Saving Water and Energy at Wastewater Treatment Plants

Energy is needed to pump, treat, and deliver water to homes and businesses. For a municipality, the energy costs for managing water and wastewater can represent one-third of electricity costs. Oregon Association of Clean Water Agencies has actively partnered with its member agencies, providing training and best practices to drive down the use and cost of electricity in Oregon's wastewater treatment plants.[6] The association named the City of Gresham its outstanding member agency for 2015 for becoming a "net-zero energy" wastewater treatment plant. Gresham's activated sludge treatment plant generates all the power it needs to drive the wastewater plant through best-in-class energy conservation, a ground-mounted solar photovoltaic array, and co-generation engines driven in part by fats, oil, and grease collection. The City saves $500,000 annually on power bills, while generating $250,000 annually from fats, oil, and grease hauler tipping fees. Gresham is the first wastewater utility in the Pacific Northwest to reach net-zero energy status and one of only a handful in the United States.

### Saving Water and Energy through Building Codes

Building codes provide a basic starting point for water and energy savings in both residential and commercial buildings. Oregon has mandatory building codes in 11 different specialty areas, including plumbing (e.g., faucets, showerheads, urinals, and toilets) and residential energy efficiency (e.g., water heaters).[7]

To provide guidance to local jurisdictions on water conservation, the State of Oregon Building Codes Division approved Statewide Alternative Methods in 2008 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.[8] A few of these methods were updated in 2010. The Building Codes Division has also published a series of Oregon Smart Guides for consumers; two of those guides focus on rainwater harvesting and water conservation systems.[9]

The Division completed rulemaking on its Oregon Plumbing Specialty Code in October 2017. The new rules place a renewed emphasis on installing WaterSense® fixtures, such as low-flow or dual-flush toilets, and also updated the language around rainwater catchment systems.

### 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 13 gallons of water per load, compared to the 23 gallons used by a standard machine. Depending on use, this can result in a savings of 3,000 gallons of water per year.

Some utilities in Oregon offer incentives for installing ENERGY STAR appliances, some even offer incentives for premium water-heating technologies, such as tankless and heat pump water heaters, that help reduce the energy needed to heat water in the home.

As discussed in Chapter 4, water-saving appliances in the home include updated toilets, dishwashers, and washing machines, with faucet aerators and low-flow showerheads common as well.

### Saving Water and Energy in Agriculture

Pumping and moving water, especially groundwater, can require significant energy for agriculture and businesses. Agricultural producers are looking for ways to save on water and energy-related costs. The 2013 State of the Agriculture Industry Report by the Oregon Board of Agriculture describes an upward trend in the number of producers adopting changes that result in energy and cost savings.[10] Nearly 5,000 Oregon farms reported changes made in the previous five years to their equipment or management practices that reduced energy use or conserved water.

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 are some of the most popular types of multi-benefit projects. Farms often employ the use of efficient water application equipment, energy-saving pumps and motors, soil moisture monitoring programs, and precision fertilizer applications.

Achieving greater efficiencies in water application—for example, moving from gravity-powered systems to pumped systems—may simultaneously increase the demand for energy, driving up energy costs. This increased energy cost may outweigh the water-use efficiency benefits, and should be considered during the design of a project.

Grants and incentives are offered by the U.S. Department of Agriculture and Energy Trust of Oregon to encourage installation of more energy efficient irrigation and renewables. A variety of measures are supported by public utilities, including the installation of freeze-resistant stock watering tanks and low-energy precision irrigation equipment.

### Cross-Sector Coordination

Addressing the water-energy nexus cannot occur in isolation; the state must focus on cross-sector and cross-agency collaboration to develop solutions. Oregon's state agencies, working with their civic and industrial partners, should focus efforts on maximizing the efficient use of our water resources, particularly with respect to the generation of low-carbon electricity. Developing new partnerships between the water and energy sectors to better understand how energy is used in water services and how water is used in energy production is critically important.

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

Examples of how to implement this action:

- Move toward energy independence for publicly operated treatment works (wastewater treatment)
- Continue to implement and evaluate building codes that encourage water and energy efficiencies
- Encourage individuals, communities, industries, and businesses, including agriculture, to look for and integrate ways to conserve both energy and water
- Encourage cross-sector and cross-agency collaboration to achieve energy and water savings
- Strive to capture and publicly report energy and water savings data

**Highlight Box**

**Saving Water and Energy Go Hand in Hand**

Since 2009, WyEast RC&D Council has implemented a Save Water Save Energy program that supports agricultural water users across Oregon. Often times, water conservation projects in the agriculture sector can also save substantial amounts of energy. WyEast partners with extension specialists and other irrigation professionals to connect agricultural producers and rural small business owners to programs that offset the costs of making system upgrades or changing management practices. Some upgrades pay for themselves in a matter of years due to the energy savings and increased yields.

WyEast has been a leader throughout the region with helping irrigators find and adopt innovations in water and energy management. The orchards throughout the Columbia River Gorge have been early adopters of these technologies and management practices. With the combination of improved irrigation systems and soil moisture monitoring, some irrigators have seen water savings near 50 percent, all while the crop quality and yields have improved.

"We're only losing about 4 percent [of water] to wind drift and evaporation, which means a lot more water gets to the ground per gallon. We're saving water and saving energy."

– Troy Peters, Extension Irrigation Specialist

Find more information at: http://www.wyeast-rcd.org/

# Critical Issue – Climate Change

The statute directing the development of the Integrated Water Resources Strategy highlights climate change in several places. For instance, it calls for recommendations regarding continuous monitoring of climate change effects on Oregon's water supply, and for recommendations useful to water users. 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 availability, water rights, crop production, and migration patterns.

The consensus among global climate scientists is that climate change is occurring and that its impacts are already being felt. The *Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (IPCC) states that warming is undeniable, and since the 1950s many of the observed changes are unprecedented.

The IPCC further notes that continued emission of greenhouse gases will cause further warming and long-lasting changes throughout the climate system, increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystems.[11]

Increased air temperatures, changing precipitation patterns, and sea level rise all have potential consequences for Oregon's water resources; wetlands, estuaries, lakes, rivers, and streams, even groundwater. 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.

## Support Climate Change Research and Partnerships in Oregon

Many local, state, federal, and tribal governments are conducting climate change research, identifying and assessing risks and actions specific to the Pacific Northwest. Several of Oregon's drainage basins have been the focus of these latest research efforts, which will help water managers and natural resources agencies develop placed-based strategies for addressing climate-related impacts on water quality, water quantity, and ecosystems. Today, there are many opportunities to further collaboration between local partners, governments, and research institutions.

### Oregon Climate Change Research Institute

The Oregon Climate Change Research Institute (OCCRI) has been tasked by the Oregon Legislature to lead climate change research among faculty of the Oregon University System. In 2010, OCCRI released the first *Oregon Climate Assessment Report (OCAR)*, a compendium of research on climate change and its impacts on Oregon. The third edition of the OCAR was released in January 2017.

Researchers at OCCRI are examining climate change impacts on a regional scale, looking specifically at risks to the Pacific Northwest. The National Oceanic and Atmospheric Administration 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, 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 and has been home of the Regional Integrated Sciences and Assessments (RISA) for the Pacific Northwest since September 2010, one of ten RISAs in the country.

### Oregon's Climate Change Adaptation Framework

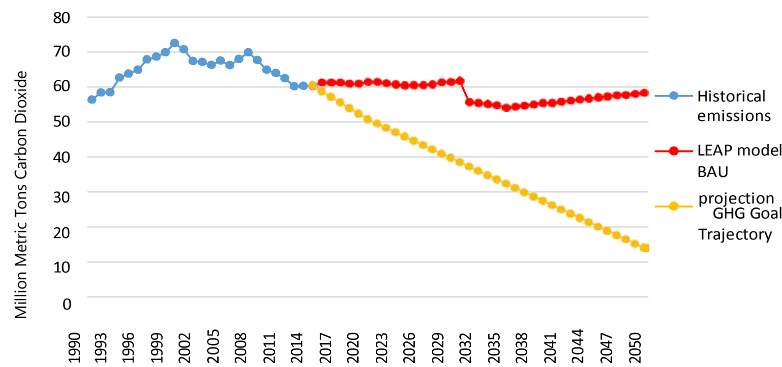
In 2010, the Oregon Department of Land Conservation and Development led an interagency effort to develop the *Climate Change Adaptation Framework* for the State of Oregon.[12] The Adaptation Framework provides a broad-scale qualitative assessment of risks to people, infrastructure, communities, and natural resources that are expected to result from the effects of variable and changing climate conditions. The Framework was developed in parallel with OCCRI's first *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 over the next three to five decades. The Adaptation Framework was used to guide a series of workshops on the north coast, where participants discussed climate projections and associated risks specific to their place. This proof-of-concept project was meant to align various climate change adaptation efforts. A regional framework was co-developed by participants, with support from Oregon Sea Grant and the Department of Land Conservation and Development.[13]

### Oregon Global Warming Commission

In 2007, the Oregon Legislature, through passage of House Bill 3543, established the goal of reducing greenhouse gas emissions by 10 percent below 1990 levels by the year 2020.[14] By 2050, those emissions have to be at least 75 percent below 1990 levels. That legislation also created the Oregon Global Warming Commission, which is tracking progress towards the goal. In 2013, Oregon agencies compiled a comprehensive inventory that utilizes data reported directly to the state via the Oregon Greenhouse Gas Reporting Program. In its 2017 Biennial Report to the Legislature, the Global Warming Commission noted that Oregon's greenhouse gas goals are not likely to be met with existing and planned actions.

The Report says that the largest part of Oregon's greenhouse gas emissions is not from energy utilities, but from the transportation sector. The Global Warming Commission says the decline in Oregon's diesel and gas emissions ended around 2015. The increase in transportation emissions since then is attributed to stagnant vehicle fuel efficiency and a rise in miles traveled by Oregonians.

**Figure 3-2: Projection of Greenhouse Gas Emissions**




A model, called "Long-range Energy Alternatives Planning," was developed for the purpose of conducting long-term energy and greenhouse gas forecasts and associated scenarios. The Global Warming Commission is using the forecast to show the direction the state's emissions are headed, absent of additional policy intervention (see Figure 3-2).

Despite the anticipated reductions resulting from Oregon's renewable portfolio standard and other policies, the state's emissions are not expected to come within striking distance of either the statutorily mandated 2020 and 2050 emission reduction goals, or the 2035 interim goal of being 40 percent below 1990 levels, as proposed by the Global Warming Commission.[15]

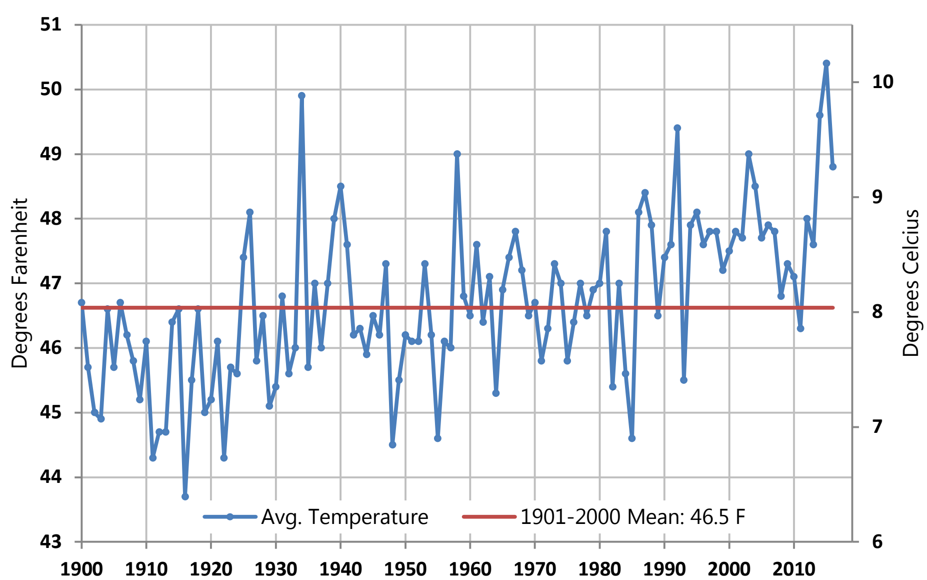
## Climate Change Projections for Oregon

Changes in climate are already visible in Oregon. Increasing temperatures are affecting the form of precipitation, and therefore Oregon's mountain snowpack. This is altering the timing, duration, volume, and quality of water runoff throughout the state. The following is a summary of some of the impacts and risks identified in the *Climate Change Adaptation Framework*, OCCRI's *Assessment*, and other recent studies.

### Increasing Air Temperature

Oregon's mean temperature has warmed by 2.2 degrees Fahrenheit since 1895, with the warmest year on record in 2015.[16] Under a scenario of continued increasing greenhouse gas emissions, Oregon's climate is projected to warm on average 3–7 degrees Fahrenheit by the 2050s. If global greenhouse gas emissions level off by mid-century, warming would be limited to 2–5 degrees Fahrenheit by the 2050s.[17]

**Figure 3-3: Oregon's Average Temperature, January to December**
based on NOAA weather data from 1901 to 2016

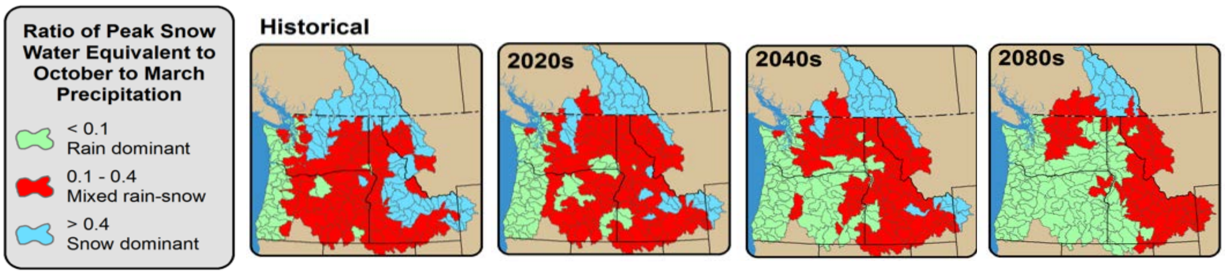


Annual precipitation is projected to increase slightly, although with a high degree of uncertainty. Summers are expected to warm more than the annual average and are likely to become drier. Extreme heat and precipitation events are expected to become more frequent.

## Declining Winter Snowpack

As mean annual temperature increases, the percentage of precipitation that falls as rain instead of snow will increase. Oregon is classified as 75 percent mixed-rain-and-snow for the twentieth century climate. By the 2080s, all of Oregon, except for parts of the Blue Mountains, is projected to become rain-dominant (Figure 3-4).[18]

**Figure 3-4: Changes in Snowpack from 2020 -2080 (A1B Emissions Scenario)**

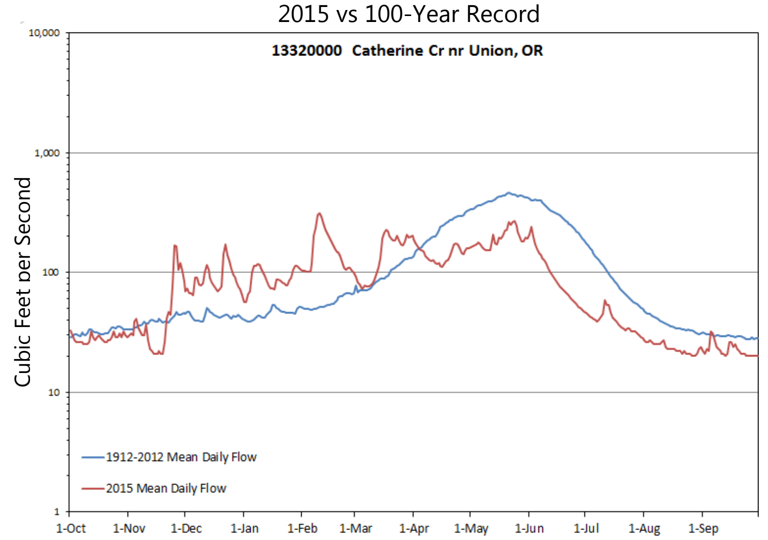



*Source: Hamlet, et al., 2013*

Precipitation that arrives as rain instead of snow runs off the landscape sooner, reducing groundwater recharge and streamflow in the late spring and summer. Hydrologic models project that by mid-century the peak runoff from snowmelt will occur three to four weeks earlier than the current average across the Pacific Northwest.[19]

**Figure 3-5: Mean Daily Flow in Catherine Creek**

2015 vs 100-Year Record




An example hydrograph in Figure 3-5 from Catherine Creek near the City of Union is representative of the hydrologic conditions experienced during 2015, a record-low snowpack year for Oregon. Peak run-off for Catherine Creek usually occurs around the beginning of June at a rate of 7,000 cubic feet per second (blue line). Under warmer winter temperatures, precipitation arrived as rain instead of snow. Flows entering Catherine Creek peaked in February and waned long before the end of the growing season (red line).

Without snowpack providing natural storage, Oregon will be less able to meet instream and out-of-stream needs during the summer and fall months, when demands are often greatest.

Storing water, via built and natural systems, will be an important tool to meet 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.

## Decreasing Water Quality

High water temperatures are already a major water quality concern in more than 16,000 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 lacking. A decline in summer streamflow will exacerbate the increase in water temperature, because low volumes of water can heat up more quickly than larger, faster streamflows. Although very few studies have been conducted to directly link harmful algae blooms to climate change, earlier or longer lasting blooms may be expected under warmer conditions in the future.

In snowmelt-dominated watersheds, an earlier occurrence of peak streamflow and snowmelt in the spring will result in decreased summer and fall flows, warmer summer water temperatures, and increased sedimentation, all of which have negative consequences for natural systems, salmonids and other estuarine and marine populations.

## Impacts to Coastal Systems

The coast is already vulnerable to a number of hazards, and these will be further exacerbated by climate-related impacts. Winter storms have historically been the primary factor for coastal erosion and flooding. The combination of increasing wave heights and rising sea-levels presents a substantial threat to the Oregon coast. Such threats include increased erosion and the loss of some beaches and coastal lands.

Sea-level rise will also have impacts beyond the coast, affecting tidally-influenced rivers and surrounding inland communities, where rising river levels can pose flooding problems. Other threats include increasingly stressed infrastructure built under older engineering standards. Infrastructure at risk can include water treatment plants, diversion facilities, and wastewater plants. The intrusion of salt water will pose a risk in some communities.

The Oregon Coastal Management Program at the Department of Land Conservation and Development is leading an ongoing project to inventory various assets, such as water infrastructure, that is most likely to be affected by sea level rise in 21 of Oregon's estuaries. The project will help prioritize areas to focus future resources and further study. Thus far, when considering sea level rise projections for 2030, 2050, and 2100, four municipal water intakes and eight wastewater treatment plants are potentially at risk to future flooding.

This exposure inventory project represents the first step in sea-level rise adaptation planning. Once completed, the inventories will be made available on the Oregon Coastal Atlas, an online depot of spatial analysis tools, planning, and other datasets for coastal systems.

## Impacts to Groundwater Systems

The 2017 Oregon Climate Assessment Report notes that, across the west, reduced snowpack is expected to result in declines in mountain groundwater recharge, affecting aquifers that are recharged from mountain systems. The timing of groundwater discharge to streams may also shift, possibly reducing baseflows in the late summer months. Much of this change largely depends on the hydrogeologic setting and a stream's sensitivity to climate change.

This decrease in groundwater supply becomes evident later in the water year when water users place greater demands on the resource. Longer and drier growing seasons generally result in an increased demand on groundwater and increased consumption of water for irrigation. With a rise in temperature of approximately 1.8 degrees Fahrenheit, irrigation demands are projected to increase by at least 10 percent in arid and semi-arid regions, translating into higher pumping and energy costs.[20]

## Impacts to Wetlands & Forests

Sufficient scientific evidence suggests that climate change is now having and will have significant impacts on coastal, estuarine, and freshwater wetlands. Sea-level rise and ocean acidification will likely affect tidal wetland habitats and the species they support. Wetlands can be sensitive to small changes in precipitation and temperature. These climate-sensitive habitats, including vernal pools, springs, and seeps support a variety of unique species, including threatened and endangered species.

Higher summer temperatures and earlier spring snowmelt are expected to increase the risk of forest fires. In the Pacific Northwest, the length of fire season has increased from 23 days in the 1970s to 116 days in the 2000s.[21] An increase of insect outbreaks, wildfires, erosion, and changing species composition in forests will pose challenges for ecosystems and significant challenges for water management.

### Impacts to Aquatic Species & Habitat

Changes in hydrologic regimes, such as the timing and extent of streamflow, have been observed in recent historical data and are expected to alter key habitat conditions for salmon and other anadromous fish that depend on specific conditions for spawning and migration.[22]

For example, increased winter and early-spring streamflows have the potential to scour eggs or wash away newly emerged fry of fall-spawning salmon and trout species. Extreme low summer streamflows can limit the accessibility for some species to move upstream to spawn. The impacts of climate change on the region's salmonids will vary across the region and among different species, populations, life-stages, and site characteristics.[23] [Note: revised and moved sentence regarding resiliency and habitat restoration to "adaptation and resiliency strategies].

### Impacts to Human Health

The Oregon Health Authority published its 2017 Oregon Climate and Health Resilience Plan to alert Oregonians to the risks associated with a warming climate and building climate resilience.[24] With regard to water, the *Plan* notes that human health could be compromised by both drought and increased water temperatures, leading to conditions that result in harmful algal blooms and waterborne diseases. At the other end of the spectrum, flooding conditions caused by rapid run-off and increased precipitation can overwhelm drinking water intakes and sewer/wastewater systems alike.

### Impacts to Population Growth and Shifts

Despite the risks outlined above, Oregon may be relatively well off compared to other areas of the country. A number of media and academic reports have focused on the concept of "climate refugees" or "climate migrants," referring to those seeking more hospitable climates in the Pacific Northwest, compared to the hot and arid southwest. Researchers out of Portland State University and University of Washington Climate Impacts Group convened a symposium of experts in 2016 to debate not only the probability of this phenomenon but the impacts as well. They asked participants, "Do we need to be planning for more [population] growth in Washington and Oregon because of climate change, and if so, what would a systematic framework for developing and updating migration scenarios look like?"

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

Examples of how to implement this action:

- Make improvements in surface water and groundwater monitoring, flood and drought frequency projections, and long-range forecasts
- Improve climate change projections at a basin scale
- Develop reliable projections of basin-scale hydrology and associated impacts on built and natural systems, including aquatic species and habitat

Captured in a symposium document called, *Winds of Change? Exploring Climate Change-Driven Migration and Related Impacts in the Pacific Northwest*, participants clearly voiced a need to better understand if and how climate change-driven migration may affect existing assumptions about population growth in the region.[25] However, they generally felt it would be premature to make changes to current population forecasting models. Instead, they argued, researchers and decision-makers should work on identifying the additional information needed and should commit to expanding research and information around climate change-driven migration in the Northwest.

### Next Steps

Oregon should continue collaborating with existing climate change research organizations and institutions to improve climate change projections at a basin scale. Basin-scale data are needed to help Oregonians prepare responses and strategies to address climate change. These include: identifying basins susceptible to changing flow regimes, establishing gages to quantify the rate of change in the magnitude, frequency, duration, and timing of streamflow; identifying groundwater systems with areas of recharge within the rain-snow transition zone; monitoring groundwater level responses to climatic impacts; and working with the U.S. Geological Survey and other partners to support long-term, natural streamflow monitoring stations that have previously been used to assess climate impacts on water supplies (e.g., U.S. Geological Survey Hydro-Climatic Data Network stations, and Geospatial Attributes of Gages for Evaluating Streamflow stations).

## Assist with Climate Change Adaptation Strategies

Each summer, Oregon is water-short, with junior water users regulated in favor of senior water rights. In the winter, communities will often experience flooding in neighborhoods, along rivers, and streams. Climate change exacerbates the conditions at both ends of the scale—from drought and fire to heavy rain and snow. In 2015 and 2016, Oregon sustained significant losses to crops, livestock, recreation, property and infrastructure, and species and habitat. Extreme conditions are being felt across entire ecosystems.

These wide-ranging impacts mean that all sectors—public and private—must implement adaptation and resiliency strategies.

### Adaptation and Resiliency Strategies

Oregonians do know that a successful adaptation and resiliency portfolio will draw upon many of the water management and planning actions described in the 2017 Strategy. The state needs to update its climate adaptation framework to strengthen efforts around climate resiliency strategies. Convening a coordinating body of agency staff to collaborate on climate adaptation across sectors is needed. Other states, for example, have created action teams to develop climate adaptation planning guides for local governments to assess vulnerabilities and develop strategies. Climate adaptation can be supported by the following recommended actions:

- **Planning.** Use existing planning processes to host these discussions and develop adaptation/resiliency strategies (Recommended Actions 9.A-C).

- **Research and Monitoring**. Climate change adaptation will require continued research and investments in climate monitoring and data mining, as well as a better understanding of changing needs and demands (Recommended Actions 1.A-1.C, 2.A, 3.A).

- **Education and Outreach**. Building climate resiliency will require active involvement of water users across all sectors. For example, improving methods around soil and tillage practices, and adjusting cropping patterns and crop selections may be needed in the future. Changing our practices will require not only more research, but targeted education and outreach efforts (Recommended Action 8.C).

- **Permitting.** Permitting and zoning decisions play a significant role in climate change adaptation. Municipal, agricultural, forest, coastal and other lands play an important role as well. (Recommended Actions 6.A-6.C).

- **Projects**. Water efficiency (Recommended Action 10.A) and reuse projects (10.C) will stretch water supplies. Storage (10.B) will help with resiliency, much like having a multi-day supply of water in the home can bridge household needs during emergencies. Non-traditional and market-based approaches may hold potential for adaptation that we have not even begun to realize (10.E). Likewise, protecting and restoring the health of streams, wetlands and floodplains, and improving riparian zones, uplands, and forests are efforts that should be continued, strengthened, and prioritized amongst private and public partners to improve ecological resiliency to climate change (11.A-11.D). Some of the techniques that may help with this work include protecting cold water refugia, ensuring floodplain connectivity, and protecting or restoring natural storage.

### Creating Resilient Water Utilities: An Industry Approach to Climate Adaptation

The change in runoff due to impervious areas has resulted in channelized and degraded streams. These urban impacts will be exacerbated by anticipated changes in rainfall patterns. Building resiliency in an urban environment can include use of green structures and low impact development, as well as stream restoration projects that can create more stable systems, retain water, and improve access to floodplains. These concepts are discussed later in the land use and water section.

Increased runoff, storm events, and sedimentation can greatly impair water and wastewater treatment facilities, causing them to be overwhelmed and taken off-line. When this happens, waterways experience increased pollution and communities experience higher treatment costs.

Over the years, the U.S. Environmental Protection Agency has created resources to help water providers develop and implement long-range climate adaptation options. Water sector utilities in Oregon should consider use of EPA's tools and guidebooks to prepare for climate change and extreme weather events. Utilities will need to ensure that they are capable of providing water and wastewater in the changing climate. This can be done by making water utilities more resilient— providing buffers, shoring up diversion, storage and transmission infrastructure, building in system redundancy (e.g., backup supplies, intergovernmental agreements), and further pursuing resiliency projects in partnership with neighboring communities.

### Water Rights and Climate Change

The shift 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. The implications of this could be particularly significant for water right holders who have historically relied on live flow surface water during the summer months.

In Oregon and throughout much of the west, states have adopted a series of court decrees and administrative rules that guide the timing of water withdrawals. "Irrigation seasons" are described in these documents, using specific dates. Prime growing conditions, however, are shifting to earlier in the year and have lasted longer, because of gradual changes in temperature. For example, some growers in the Willamette Valley that have their irrigation seasons defined on paper as April 1 through September 30 are experiencing growing conditions that could benefit from irrigation into the month of October. Other water rights have defined irrigation seasons of May 1 through September 30. In recent years, however, they have experienced growing conditions that could allow them to plant well before May. This increased demand for water in the early spring or late summer could happen more frequently in the future under a changing climate.

Irrigators and other water users may eventually find themselves holding legal documents – water rights – granting permission to use water during seasons that bear very little resemblance to the conditions taking place outside their windows.

Policymakers may one day have to revisit the body of rules that define irrigation seasons that were based on historic conditions. Although the process may take some time, the result could be a set of laws that align more closely with actual conditions in the field. States such as Oregon that have constructed laws in a sound manner with a strong scientific foundation have a good start. Making adjustments incrementally will be important for maintaining this strong foundation, while keeping up with a changing climate.

Similarly, 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. Future efforts should include an analysis of how instream and out-of-stream water rights would fare with significant hydrologic changes.

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

Examples of how to implement this action [changed order of bullets]:

- Provide technical support to communities to incorporate climate change impacts into their planning decisions
- Look for more efficient ways to conserve, store, and reuse water to benefit instream and out-of-stream uses
- Support ecosystem resiliency to climate change through habitat protection and restoration projects
- Analyze how instream and out-of-stream water rights will fare with hydrologic changes
- Promote use of the U.S. Environmental Protection Agency's current resources and tools for utilities

# Critical Issue – Extreme Events

Since the adoption of Oregon's first Strategy in 2012, the state has recorded its warmest year (2015), experienced the lowest snowpack on record (2015), had one of the most severe wildfire seasons and declared drought emergencies in 25 counties (2015), and was declared a major national disaster area by President Obama for damage cause by extreme storms, floods, and landslides in February 2016. Water year 2017 also proved to be a year of weather extremes for the Pacific Northwest. Portland, for example, experienced its fifth-coldest winter on record, with an average temperature of only 37 degrees. The dry conditions in May through July 2017 were the 5$^{th}$ warmest on record in the 123-year record, contributing to an intense wildlife season across the state.[26]

Recognizing that extreme weather events, such as drought, floods, and earthquakes occur at great cost to society, Oregon communities must prepare themselves for these natural hazards. The negative impacts of such events can be far-reaching and may exacerbate already existing water challenges, such as water scarcity, water quality, and instream habitat conditions.

In this document, we use the term "community" broadly to mean a group of people bound by a common geography, background, or interest. A community might concern itself with ecological and instream interests; it might also concern itself with human or economic needs. These concerns are not mutually exclusive and may overlap quite a bit. A community's vulnerabilities may differ by geography, water-use sectors, income, ability to access storage or additional water supplies, and other factors. Vulnerabilities might be lessened through improved forest health, wetland capacity, natural storage, and floodplain health.

Public, private, tribal, and non-profit organizations working together, as well as individuals who take personal responsibility for thorough preparation, will be critical for Oregon to withstand these extreme events. Key organizations will be those who can play roles in mitigation, communication, response, and recovery. Their work will be to design resiliency into community planning, determine which communities are vulnerable and how, and document the economic, social, environmental, and other impacts of such events.

The state for its part may need to facilitate innovation in adopting and implementing policies, procedures, regulations, and zoning that allow flexibility, while protecting human health, social systems, economic systems, the built environment, and natural systems.

## Build Drought Resiliency in Oregon

In July 2015, Governor Brown issued Executive Order 15-09 calling for several drought and climate-related actions.[27] Among these, state agencies were directed to build drought resiliency measures into the Integrated Water Resources Strategy. Oregon experienced severe-to-extreme drought across the entire state that year. For some communities, 2015 marked the third, or in some cases, the fourth year of continuous drought conditions. The drought not only affected Oregon, but the entire west coast.

Twenty-five of Oregon's 36 counties received a drought declaration from the Governor in 2015 – more than any other year since 1992.

In the case of severe or multi-year droughts, soil moisture does not recover in time for the next growing season. Groundwater levels do not rebound and refilling reservoirs can prove difficult. Because droughts are a slow-moving disaster where impacts develop over time, persisting even after the rain and snow returns, building drought resiliency in Oregon will require a portfolio of water management methods that are put into place long before the next drought arrives.

### Defining Drought

Precipitation and temperature are the main drivers of drought, and largely determine snowpack, soil moisture, and streamflow levels, which are commonly used as indicators of drought. In Oregon, many watersheds depend heavily on snowpack for annual water supply, and the timing of peak runoff from snowmelt is critical.

As noted in Oregon's 2016 *Drought Annex*, a drought response plan within the state's emergency operations plan, droughts can generally be characterized by an increased demand or decreased supply of water.[28] In the early 1980s, researchers with the National Drought Mitigation Center (NDMC) and the National Center for Atmospheric Research located more than 150 published definitions of drought. In order to simplify analysis, the NDMC now provides five different ways in which drought can be defined.

- **Meteorological Drought –** Meteorological droughts are usually defined on the basis of dryness, compared to some type of normal or average amount. Due to climatic differences, what might be considered drought in one location of the state may not be the same in a different location. The concept of a "snow drought" has emerged in recent years. Experiencing below average snowpack with above average precipitation, as was the case in 2015, has spurred the study of snow droughts.
- **Hydrological Drought –** This definition of drought describes a situation that occurs when surface and subsurface water supplies are below normal, caused by shortfalls in precipitation, including snow. A hydrological drought usually lags behind a meteorological or agricultural drought. Low precipitation takes longer to show up in streamflow and groundwater, for example.
- **Agricultural Drought –** An agricultural drought occurs when the amount of moisture in the soil no longer meets the needs of a particular crop. This type of drought links together the various characteristics of meteorological (or hydrological) drought to agricultural impacts.
- **Socioeconomic Drought –** This refers to the situation that occurs when physical water shortages begin to affect people and the supply of economic goods and services.
- **Ecological Drought –** A prolonged and widespread deficit in available water supplies — including changes in natural and managed hydrology — that create multiple stresses across ecosystems.

Drought is not an abnormal occurrence in Oregon, with notable droughts in the 1930s, 1976-77, 1992, 2001-02 and 2012-2015. In the future, Oregon might see dry winters with little precipitation and limited snowpack accumulation. Warm winters may also be common, with more precipitation falling as rain rather than as snow, leading to earlier runoff. One might also see dry summers, with little precipitation available during the driest months of the year.

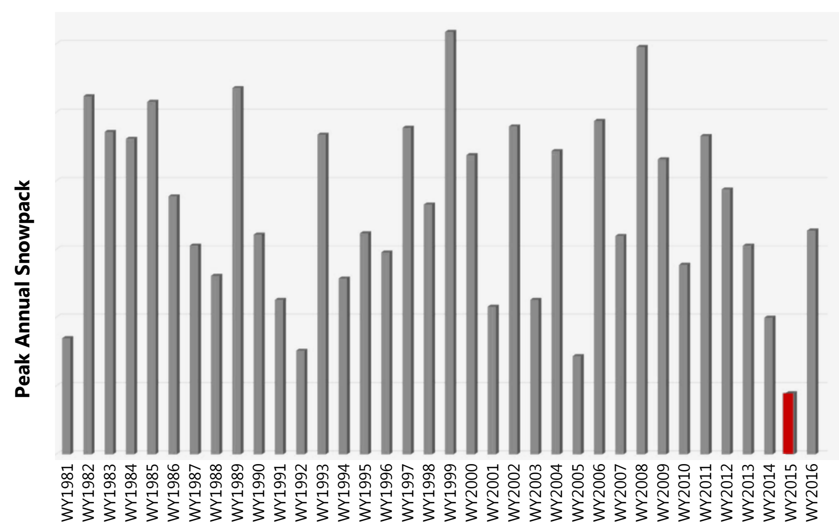
High temperatures in the summer can exacerbate drought conditions, as increased temperatures can reduce soil moisture and increase rates of evaporation and evapotranspiration. These conditions can lead to limited water supply for livestock and crops, reduced irrigation deliveries, and poor yields. Warm summer temperatures can also cause changes in the timing of water supply and water quality issues (e.g., algae blooms and waterborne diseases).

### Drought Conditions in 2015

Although winter precipitation amounts were relatively average during 2015, it was Oregon's warmest winter on record. January and June were the most unusually warm months for Oregon that year. The average temperature in January was 38.1°F (7.4°F warmer than the historic average) and the average temperature in June was 65.6°F (8.3°F warmer than the historic average). Oregon's statewide average temperature for the entire water year was 50.8°F (4.2°F warmer than the historic average).

The warm temperatures during the winter led to a dismal snowpack, the lowest on record since 1981 (see Figure 3-6). Most of the precipitation that fell came as rain, not snow. With continued warming, this type of snow-drought is expected to occur more often in the future.

**Figure 3-6: Oregon's Peak Annual Snowpack**
Water Years 1981-2016




Snow melted earlier than normal, and there was less continuous runoff available during the summer months. Severe conditions continued throughout the year, as the state also faced the warmest and driest summer on record.

The U.S. Drought Monitor, produced through a partnership between multiple entities, takes into account factors such as temperature and precipitation. It does not, however, adequately reflect soil moisture conditions, real-time snowmelt (run-off), or future forecasts. These missing variables are key pieces of information needed to understand near-term and short-term drought conditions. Oregon needs a better set of indicators that signal differing stages of drought and that can be used as a planning, communication, and response tool.

### Impacts and Responses to the 2015 Drought

The 2015 drought, and the dry conditions leading up to it from previous years, had varying impacts over time and across Oregon's regions, sectors, and economies. The Integrated Water Resources Strategy partner agencies held open houses and conducted an online survey to learn about how the drought affected communities across the state, and how people responded. Participants were also asked what actions should be pursued to better prepare for future droughts. Several thoughtful and useful strategies were suggested, making it clear that drought has impacts on every aspect of our way of life in Oregon.

**Fisheries Impacts –** There were several significant fish die-offs in 2015, including in the Willamette, Clackamas, John Day, and Deschutes Rivers and some hatcheries, where high water temperatures amplified the effects of a naturally occurring parasite called Ichthyophthirius (Ich) and a bacterial fish disease known as columnaris. Mortality caused by drought not only affects existing fish, but also may result in lower numbers of fish in future generations. Half of Oregon's hatcheries were affected by drought conditions in 2015.

The Department of Fish and Wildlife implemented a daily fishing curtailment regulation in nearly every stream in Oregon in 2015. This was the first time that a statewide curtailment was implemented. The daily curtailment began in mid-July in response to extremely high water temperatures and early season low water levels. Due to these extreme conditions, streams were closed daily to fishing for trout, salmon, steelhead, and sturgeon from 2:00 pm to one hour before sunrise. These closures were implemented to avoid any additional stress on fish from fishing activity.

**Drinking Water –** Communities responded to water shortages in 2015 in a number of ways. Several municipalities engaged in targeted water conservation and curtailment messaging to their customers to stretch water supplies. Some communities, like the City of Ashland, ramped up outreach efforts within their ongoing water conservation programs, which commonly provide financial rebates for residents who replace toilets, dishwashers, and washing machines with more efficient systems. The record low river flows caused by the drought led to water quality issues at some municipal intake structures as well.

**Recreation –** The drought also strained summer recreational activities, such as skiing, boating, fishing, and hunting, as well as the local economies that depend on visitors. Detroit Lake, for example, saw a 26 percent decline in visitors due to low water levels and inaccessible boat ramps.[29]

Winter recreational activities also felt the impact of a record-low snowpack. Mt. Ashland ski resort wasn't able to open during the 2014-15 ski season. Ski managers got creative, using snow-harvesting and other strategies to allow the resort to stay open in 2015-16.[30]

**Agricultural-Related Impacts –** Limited water supply and high temperatures damaged certain crops and reduced yields, and ranchers in multiple counties struggled with dry pastures and limited water for livestock. Heat-stressed cattle were fed supplemental rations to help provide necessary nutrients. Some ranchers shipped cattle to feedlots earlier than normal or weaned calves early, due to a lack of feed and water.[31]

Many irrigators planted fewer crops and left land idle, enabling them to use more of their water allotments on other plots. It has been estimated that eastern Oregon farms in Treasure Valley received a third of their normal irrigation water, due to low storage in Owyhee Reservoir[32]. Some farmers switched to different crops, planting higher value crops, such as onions and beets, or moving to lower value crops that require less irrigation, such as grain and seed crops. These management decisions are heavily dependent on both expected water supply and market prices.[33] Federal funding programs were made available to help recoup expenses from damage to crops or herds.

In some areas, the state's watermasters had to shut off irrigation for water right holders much earlier in the season than normal, shutting off more senior water right holders—some for the first time ever. Many growers were allocated less water than normal. Situations like these prevented some small farming operations from planting crops at all.[34]

**Wildfires –** Several state and federal agencies are involved in wildland fire suppression in Oregon. The 2015 fire season for the Pacific Northwest was notable for its severity and cost. The U.S. Department of Agriculture reports that more than 630,000 acres burned in Oregon during the fire season and characterized 2015 as the "most severe in modern history from a variety of standpoints."[35]

The Oregon Department of Forestry estimates that large-fire costs for state agencies amounted to $94.4 million, more than $70 million in additional expenses compared to the 10-year average of $22.3 million.[36]

**Lessons Learned from Drought 2015 –** Documenting drought conditions, especially its impacts on people and the environment, is an important component of understanding and preparing for future droughts. Using drought emergency relief funds approved by the Washington Legislature, the state of Washington recently completed an economic assessment that quantifies the impacts of the 2015 drought on the state's farmers and ranchers, an effort that had not previously been done at the statewide level.[37] Oregon does not have the resources to conduct a thorough analysis of drought's impact to various sectors. Today, most impact-related data is collected anecdotally. The state should invest in ways to track and quantify the effects of drought and assist the most vulnerable communities.

Any drought assessment should also include a summary of drought frequency, distribution, intensity, and duration. Doing so is critical, especially as climate projections indicate that the Pacific Northwest will more regularly experience warmer temperatures.

## A Closer Look at Drought Declarations

County-wide drought declarations go through a two-part process before securing a drought declaration from the Governor. First, County Commissions meet to determine whether they need to request a Governor's declaration. Then these requests go to the Drought Readiness Council (co-chaired by the Office of Emergency Management and Water Resources Department) for review and recommendation to the Governor.

The Governor can issue an Executive Order to declare drought—either independently or in response to a request by counties. In recent years, these Executive Orders have been set to expire at the end of a calendar year.

A Governor's drought declaration can trigger a number of requirements and water management tools not otherwise accessible. Declarations allow the Water Resources Commission to grant a temporary preference of use of water for human consumption and/or stock watering. Drought declarations also authorize the Water Resources Commission and Governor to require state agencies and local governments to develop and file water conservation and/or curtailment plans; the Governor may require the implementation of such plans. Finally, declarations allow the Water Resources Department to use an expedited process in a number of water right areas, including the issuance of emergency drought permits for groundwater.

Emergency drought permits are the most frequently used tool in the state's drought toolbox. During the past five years, the state has issued almost 90 emergency drought permits for groundwater use. Eighty of those were in the Klamath basin. During the same time period, the state approved more than 40 emergency drought transfers. Of these, eight were in Klamath County, seven were in Malheur County, seven were in Baker County, and six were in Lane County. The state must find that allocation is within the capacity of the groundwater resource in order to approve these requests; this protects existing water users. That is why some irrigators do not apply in the first place, or some emergency drought applications are not approved.

Communities and businesses looking to offset drought-related losses often turn to the federal government, which can provide payments or emergency loans after a federally-issued drought disaster designation by the Secretary of Agriculture. Federal drought funds generally cannot cover all losses suffered by producers, but they can help.

## Improving the Drought Toolbox

In 2016, the Oregon Legislature established a Drought Task Force to develop recommendations that could help improve the state's response to drought.[38] A number of the Drought Task Force recommendations also resonated with the 2016 IWRS Policy Advisory Group, which confirmed several of these in its final report.[39] Both groups called on the state to:

- Continue to increase and enrich water-related data collection to inform water use decisions, conservation, and management, as well as better anticipate and respond to drought.
- Provide resources for assessments of drought impacts, risks, and vulnerabilities on instream and out-of-stream sectors in order to better prepare for, respond to, and recover from drought.
- Provide OWRD with staff resources to do outreach and communication. Develop a communication tool box to educate all sectors and elected officials about existing tools, water conservation, drought conditions and preparedness, and help small communities respond to drought.
- Provide funding for additional watermaster staff and tools to make water distribution more efficient.
- Consider additional programs to facilitate restoration of streamflows through voluntary means during times of drought.

Some of these recommendations have broader implications than drought and are discussed in other chapters of the Integrated Water Resources Strategy; drought-specific recommendations are summarized at the end of this section.

The Drought Readiness Council, mentioned earlier, is a standing body comprised of federal and state natural resource, public health, and emergency response agencies. During a drought, the Council reviews local requests for assistance and makes recommendations to the Governor. The Council has taken a look at the drought toolbox to determine what improvements, if any, can be made at the state level. In the wake of a governor-declared drought, the Drought Readiness Council sees four potential opportunities for response at the state level:

1) **Providing Emergency Funds.** Some water managers have found that intake pipes no longer extend far enough into the stream, that pumps no longer reach water down into a well, that saline water is infiltrating water systems, and that other infrastructure is similarly inadequate. Drought has ecological effects as well, drying up reaches, stranding fish, and warming cold water refugia, for example. Emergency funding, if made available, could help address these problems and should be used to create more resilient human and ecological communities.

2) **Improving Communication through Outreach and Education**. Communication with Oregonians should not be triggered by a drought declaration, but should be in practice long before drought conditions turn severe. Outreach and education are long-term tools and resources that must in place as part of agencies' day-to-day operations. Agencies should increase awareness around drought and share best management practices. Increasing agency capacity for outreach and education is secured through the budgeting process, which agencies prepare for each biennium.

3) **Developing Drought Contingency Plans**. These plans spell out what measures water providers or individual users will undertake during times of water shortage. They help lay out conservation, storage, curtailment, and communication priorities. These plans can be voluntary, and even developed collaboratively at a basin or watershed scale among different users and interests. After a drought declaration, however, the Governor or Water Resources Commission can require state agencies or public entities, such as a city or district, to develop

such a plan. The Governor may then also require water users to implement these plans. In 2015, for example, the Governor directed state agencies to develop and implement such plans. Immediate responses from the agencies included: water-use measurement and reporting, water efficiency projects, repairs to leaky pipes, and curtailment of ornamental fountains.

4) **Creating Mandatory and Voluntary Measures.** The Water Resources Commission and Governor already have the statutory authority to give priority for water to human health and livestock in times of drought. The Governor also has broad discretionary emergency authorities. The Department of Fish and Wildlife currently utilizes a variety of strategies and actions to minimize the negative effects on fish and fisheries due to impacts from drought. These strategies include partially or completely closing a fishery or area during a portion of the day or season, or encouraging anglers to voluntarily reduce fishing when water temperatures and flows are significantly outside the normal range for a certain time of the year. Additional voluntary measures could help conserve water as well as protect streamflows during times of drought. The Department of Fish and Wildlife is interested in exploring further with its partner agencies and stakeholders how other states have used voluntary, regulatory, and funding programs to ensure minimum streamflows during drought.

## Planning for Future Droughts

A study by the Multi-Hazard Mitigation Council shows that each dollar spent on mitigation saves an average of four dollars overall.[40] Planning ahead is generally seen as more efficient and more effective than actions taken during a drought.

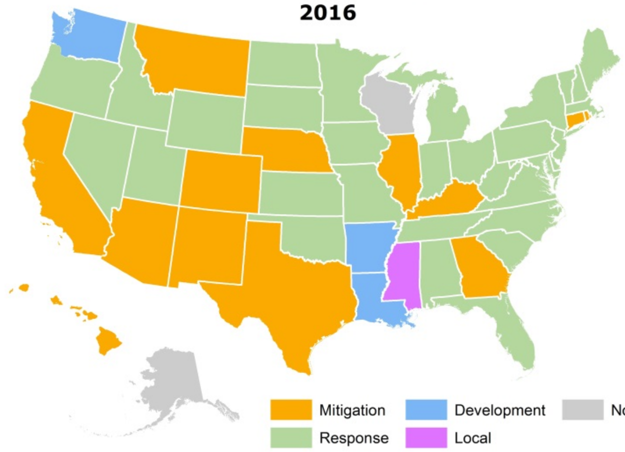
Drought is one of eleven natural hazards discussed in the state's 2015 Natural Hazards Mitigation Plan.[41] Each hazard is analyzed statewide and at a regional level. The plan contains mitigation actions, which are meant to reduce or eliminate the long-term risk to people and property from hazards. Hazard mitigation, in general, is the responsibility of individuals, industry, and government. Local governments, such as cities and counties, often develop their own multi-hazard mitigation plan.

Oregon's Natural Hazards Mitigation Plan is a component of the state's Emergency Operations Plan (EOP). In addition to preparedness and mitigation, the EOP addresses emergency operations, as well as relief and recovery efforts. In early 2016, the Water Resources Department and the Office of Emergency Management updated Oregon's incident annex on drought, which is largely a response plan for state agency coordination activities.

Most states focus solely on development of a mitigation or response plan for drought (see Figure 3-7). Rarely do you see integrated mitigation and response plans.

**Figure 3-7: Status of State Drought Plans**

**2016**




Source: National Drought Mitigation Center

A response plan focuses on short-term actions to help reduce the immediate impact of drought, whereas mitigation plans tend to address actions taken before a drought occurs in order to reduce potential future drought impacts.

Since the late 1980s, Oregon has spent most of its focus on response planning and related activities. Several states, including California, are focusing more closely on mitigation planning efforts. The state of Colorado has a combined *Drought Mitigation and Response Plan*[42], which provides a thoughtful working model for other states that are developing their own vision of drought resiliency.

**Drought Early Warning System –** The National Integrated Drought Information System is a program authorized by Congress in 2006 to coordinate and integrate drought research and create a national drought early warning information system.

Regional early warning systems have been developed through partnerships with other federal, state, regional, local and private entities with the goal of helping stakeholders in the region cope with drought.

These systems explore and demonstrate a variety of early warning and drought risk reduction strategies that incorporate drought monitoring and prediction information. The Pacific Northwest Drought Early Warning System launched in February 2016 includes Idaho, Oregon, Washington, the western portion of Montana that feeds into the Columbia River Basin, and British Columbia. Oregon representatives are participating in this group to learn about how other states in the Pacific Northwest are collecting drought-related information and using that to design drought plans, resiliency actions, and guide policy development.

**Recommended Action 5.5A**
**Plan and Prepare for Drought Resiliency**

Examples of how to implement this action:

- Assess and assist those communities and ecosystems most vulnerable to drought
- Develop the appropriate set of indicators that signal and forecast differing stages of drought
- Document the economic, social, and environmental impacts of drought, including the frequency, distribution, intensity and duration
- Prepare for, respond to, and mitigate for the impacts of drought
- Improve the drought toolbox, through education and outreach, drought contingency plans, more efficient water distribution systems, additional voluntary measures to improve streamflow, and emergency funding that increases resiliency

## Plan and Prepare for Flood Events

This section focuses on the public safety and emergency nature of flooding. Floodplain protection and restoration is discussed under the topics “water and land use” and “healthy ecosystems.”

Oregon’s mountain ranges are part of the reason there is tremendous variation in the types of flooding we experience. Although floods are a common natural hazard in Oregon, floods west of the Cascades tend to be large-scale events, while eastern Oregon typically experiences more localized, intensive events. The four types of flooding described in the 2015 Natural Hazard Mitigation Plan include:

**Riverine flooding –** The most common flood hazard in Oregon and usually occurs during winter. The most severe flooding conditions occur in “rain on snow” events, when heavy rainfall is augmented by rapid snowmelt. Longer duration storms and floods are more common in western Oregon. Very large and widespread floods occurred in parts of western Oregon in 1861, 1891, 1948, 1964, 1996 (three separate storms), and 2007.

**Flash flooding –** Flash floods are caused by extremely intense rainfall over a short period of time, commonly within a single drainage. Such events usually occur in the summer during the thunderstorm season. In eastern Oregon, local convective thunderstorms often produce the most severe flooding. One of the worst flash floods in history occurred in eastern Oregon in June 1903, killing 247 people (one-fifth of the population at the time) in the town of Heppner.[43]

**Coastal flooding –** Coastal floods result from different conditions. Winds generated by tropical storms or intense off shore low-pressure systems can drive ocean water inland, causing significant flooding.

**Urban flooding –** Urban floods occur because land is converted from fields or woodlands to roads, roofs, and parking lots, losing its ability to absorb rainfall. This transition from pervious surfaces to impervious surfaces results in more and faster runoff of water. During periods of urban flooding, streets can become swift moving rivers, and basements can fill with water. Storm drains may back up with yard waste, causing additional nuisance flooding.

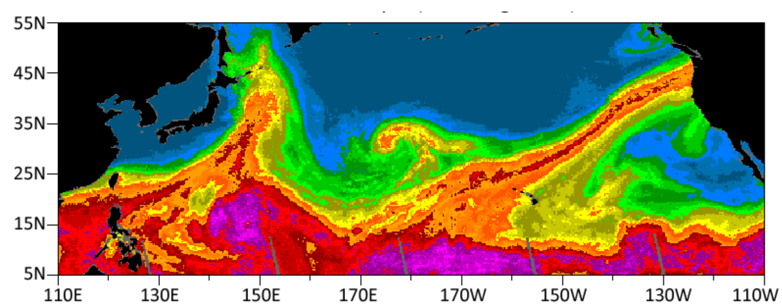
## Atmospheric Rivers

Atmospheric rivers are relatively long, narrow regions in the atmosphere – like rivers in the sky – that transport water vapor from the tropics. These columns of vapor move with the weather, capable of carrying an amount of water that exceeds the flow at the mouth of the Mississippi River. When atmospheric rivers make landfall, they often release this water vapor in the form of rain or snow. Although atmospheric rivers come in many shapes and sizes, those that contain the largest amounts of water vapor and the strongest winds can bring extreme rain and floods, often by stalling over watersheds vulnerable to flooding. These events can disrupt travel, induce mudslides and cause catastrophic damage to life and property.[44]

Atmospheric river events sometimes result in extreme precipitation events west of the Cascade Range, or isolated events east of the Cascade Range. Each year, roughly 30 percent of Oregon's winter precipitation falls in heavy, typically atmospheric river–fueled precipitation events.[45]

The Pacific Northwest regularly experiences storms caused by atmospheric rivers. In early November 2006, an atmospheric river event affected western Washington and northern Oregon, producing heavy rainfall and devastating flooding and debris flows with damages exceeding $50 million.[46] (See Figure 3-8).

**Figure 3-8: November 2006 Atmospheric River Event**




Source: NOAA Earth System Research Laboratory

## Understanding Oregon's Flood Risk

Similar to drought, Oregon should develop indicators of flood emergency stages that can be used as a planning, communication, and response tool. Oregon does not have a consolidated assessment of past floods and their economic, social, and environmental impact. Oregon should research how changes in land use, land cover, forest cover, and watersheds—including upstream impervious surfaces, geomorphology, logging, and forest fires—may change the location, strength or duration of floods, flood ways, and flood discharge. This information could be beneficial to local planning efforts.

Our understanding of flood risk in Oregon is limited, compared to other regions of the country. However, we do know with reasonably high confidence that the frequency of extreme precipitation and flooding events are likely to increase around the state under a warming climate. Oregon is one of only five states that lack up-to-date precipitation-frequency analysis prepared by the National Weather Service. Oregon also does not have a reliable extreme maximum flood document, which most other states have.

Uncertainty in precipitation information coupled with climate change and possibly more extreme precipitation events has significant implications for the safety of water resources infrastructure. The design of dams, wastewater facilities, bridges, and culverts depends on accurate precipitation estimates for extreme events.

The National Weather Service can update precipitation frequency estimates if it receives funding for such work. Oregon now relies mostly on information from 1973, with a very partial update completed in 2008. An analysis of precipitation frequency information with resulting maps and tables would provide designers and operators of water infrastructure with the most current and reliable precipitation frequency estimates to withstand floods.

Engineers need reliable information to design safe infrastructure. Agencies that have expressed support for this research include the U.S. Army Corps of Engineers, the Natural Resources Conservation Service, the Oregon Department of Agriculture, Department of Environmental Quality, Office of Emergency Management, Oregon Health Authority, and the Water Resources Department. Despite this, the project to provide current precipitation return frequency information is not yet sufficiently funded. Without better information, infrastructure is more likely to fail during a major flood and as a result, imperil public safety and property.

Where forest fires have burned and changed land cover, updated precipitation frequency information can be used in hydrologic models to predict new flows in the watershed. After a wildfire, the charred ground repels rainwater, increasing the risk of flooding and debris flows for several years. The intense storms that follow can lead to severe flooding and landslides. In light of recent drought and ensuing wildfires, state emergency managers recognize the need to be able to respond to these environmental stressors rapidly and responsibly. Installing traditional stream monitoring equipment is one option, although it can be expensive and time consuming to set up and maintain. By contrast, temporary, real-time, rapid-deployment equipment can be set up and removed quickly for early warning purposes.

### The Need for Inter-Agency Coordination

Dealing with floods and the potential for landslides requires inter-agency partnerships across multiple jurisdictions. Silver Jackets is a group of local, state, federal and tribal agencies chaired by the U.S. Army Corps of Engineers and is focused on reducing the risk of flooding and other natural disasters. Most states have a Silver Jackets program, and Oregon's program focuses on flood preparedness, communication, and recovery. While much work still remains to get adequate policies and programs in place, the group has recently launched a new website containing information and resources for use before, during, and after a flood.

The state also leads a Flood Core Team focused specifically on updating the flood-related portion of Oregon's Emergency Operations Annex.

**Recommended Action 5.5B**
**Plan and Prepare for Flood Events**

Examples of how to implement this action:

- Develop indicators of flood emergency stages, using information about meteorologic, hydrologic, hydraulic, and watershed conditions
- Document the economic, social, and environmental impacts of floods
- Evaluate potential for extreme flooding, under atmospheric rivers and climate change scenarios
- Establish early flood warning systems in areas where recent drought and wildfire have affected forests and vegetation

# Plan and Prepare for a Cascadia Earthquake and Tsunami

Seismic activity in the state has been relatively low since the time of European settlement. Up until the mid-1980s, Oregon was not considered to be at high earthquake risk. Infrastructure built before 1980 was designed with criteria based on that seismic understanding. During the past 25 years, however, geological analyses have led to a very different understanding of seismic risk in Oregon.

## Earthquakes and Tsunamis in Oregon

The Oregon Department of Geology and Mineral Industries (DOGAMI) is the lead agency for earthquake hazards. DOGAMI has created maps that identify areas in selected Oregon communities that will suffer more damage, relative to other areas, during a damaging earthquake. A clearinghouse of tsunami information is also maintained by DOGAMI and includes information for coastal residents, visitors, planners, and scientists.

There are two major types of earthquakes that occur in Oregon: megathrust earthquakes that occur along the Cascadia Subduction Zone near the coast, and smaller crustal earthquakes. For the most part, crustal earthquakes occur on shore on much smaller fault systems. The two largest earthquakes in recent years occurred in Scotts Mills (magnitude 5.6) during 1993 spring break and six months later in Klamath Falls (magnitude 5.9 and magnitude 6.0), both of which were crustal earthquakes. The last major subduction zone (megathrust) earthquake and tsunami occurred more than 300 years ago in 1700.

## A Cascadia Earthquake

The Cascadia Subduction Zone fault, shown in Figure 3-9, spans from Northern California to southern British Columbia and can produce earthquakes as large as magnitude 9.0 with corresponding tsunamis. Scientific evidence indicates that an earthquake of this size occurs along the fault on average once every 200 to 500 years.

**Figure 3-9: Cascadia Subduction Zone**

Source: Adapted from FEMA

The Cascadia Subduction Zone closely mirrors the subduction zone in northern Japan that produced the 2011 Tohoku earthquake. The incredibly destructive tsunami that resulted from the Tohoku earthquake should serve as a warning to Oregon.

When a Cascadia earthquake occurs, it will affect mostly western Oregon, and in particular, coastal communities. Following such an event, it is estimated that it will take one to three years to restore drinking water and sewer services in the coastal zone.

Available studies estimate that a Cascadia earthquake and resulting tsunami could result in 1,250 to more than 10,000 fatalities, tens of thousands of buildings destroyed or damaged so extensively that they will require months to years of repair work, tens of thousands of displaced households, more than $30 billion in direct and indirect economic losses (close to one-fifth of Oregon's gross state product), and more than one million truckloads of debris.[47]

## 2013 Oregon Resilience Plan

In 2013, the Oregon Seismic Safety Policy Advisory Commission published the Oregon Resilience Plan describing likely outcomes from a Cascadia Subduction Zone earthquake event. The plan notes:

> It is simply not scientifically feasible to predict, or even estimate, when the next Cascadia earthquake will occur, but the calculated odds that a Cascadia earthquake will occur in the next 50 years range from 7 to 15 percent for a great (magnitude of 8.7 to 9.3) earthquake affecting the entire Pacific Northwest to about 37 percent for a very large (magnitude of 8.3 to 8.6) earthquake affecting southern Oregon and northern California. The likelihood of a magnitude 9.0 Cascadia earthquake during our lifetimes and the consequences of such an earthquake are both so great that it is prudent to consider this type of earthquake when designing new structures or retrofit of existing structures, evaluating the seismic safety of existing structures, or planning emergency response and preparedness.

The Oregon Resilience Plan encompasses a set of short- and long-term recommendations regarding critical and essential structures, transportation, energy, information and communication, and water and wastewater systems. The plan notes that, "The scientific understanding of the Cascadia threat makes it clear that very large earthquakes will occur in Oregon's future, and that our societal and physical structures are poorly prepared to meet the threat unless we take action now to start building the necessary resilience."

The plan further notes that "Oregon's water and wastewater systems are especially vulnerable to damage resulting from a Cascadia subduction zone earthquake." With seismic activity including liquefaction, lateral spreading, landslides, shaking, and tsunami inundation, the vulnerabilities of water and wastewater systems are significant. The Oregon Seismic Safety Policy Advisory Commission made several recommendations to address these vulnerabilities and build the resiliency of water and wastewater systems, which are summarized below.

**2013 Oregon Resilience Plan | Summary of Recommendations from the Water and Wastewater Chapter:**

- Begin aggressive public information efforts to re-set public expectations for a realistic response time. The old guideline of having a 72-hour emergency survival kit falls far short.
- Public agencies should be advised that the Oregon Water/Wastewater Agency Response Network is a vital resource and membership is recommended.
- Service providers from all sectors should be required to have a business continuity and seismic response plan that includes resources normally provided by functioning infrastructure (e.g., food, water, and communications).
- Service providers should plan for and support employee preparedness.
- Water-related industry associations and manufacturers should evaluate the need for seismic design standards for pipelines.
- Seismic vulnerability criteria should be incorporated into overall capital improvement project planning and asset management priorities, particularly updates to water system master plans.
- The Oregon Health Authority should be encouraged to include a seismic design requirement as part of routine design review of water system improvements.
- Encourage the Oregon Department of Environmental Quality and the Oregon Health Authority to establish goals and expectations for post-earthquake regulatory compliance and applicable standards. For example, will it be acceptable to discharge into waters of the state the chlorinated water from main breaks and main repairs?
- Encourage public health, water, and wastewater agencies to plan for significant water quality impacts to rivers downstream from urban areas.

The plan further describes the vulnerabilities facing our water delivery systems. These include numerous potential points of system failure, at reservoirs, intakes, treatment plants, pump stations, and outfalls. Many materials are inflexible, joints are push-on, and pipelines may be prone to failure at connections to above-ground structures. Vulnerabilities also include interdependence with other potentially damaged systems, such as power, transportation, chemical, and financial industries. Water from leaks and breaks in water pipelines and private plumbing systems will cause collateral damage, drain available water storage, and contribute to loss of water supply and pressure, which will in turn result in a loss of fire protection capability.

Finally, the performance of gravity sanitation and storm sewers depends on accurate grades and slopes, which are disrupted by ground displacement resulting from liquefaction. Because nearly all water and wastewater treatment plants are built near rivers, they are vulnerable to liquefaction and effective mitigation may require rebuilding these plants on more stable soils.

Recommendations from the Oregon Seismic Safety Policy Advisory Commission should be implemented using a phased approach to restoration of water and wastewater services after a Cascadia earthquake and tsunami, beginning with a backbone water and wastewater system for each community, capable of supplying critical community needs.

### Seismic Retrofits

Throughout Oregon, businesses and service providers are taking another look at critical infrastructure and undergoing seismic retrofits where feasible. From roads, to schools, to hospitals, these retrofits receive sizable sums of money from the Oregon Legislature. Water infrastructure—in the agricultural, municipal, industrial, and domestic sectors—also requires seismic upgrades, but these are very expensive. Although some dams, transmission lines, and treatment plants have received state or federal funding for seismic study and upgrade, this type of funding award is uncommon.

**Recommended Action 5.5C**
**Plan and Prepare for Cascadia Subduction Earthquake Event**

Examples of how to implement this action:

- Follow the recommendations provided by the Oregon Seismic Safety Policy Advisory Commission in its *2013 Oregon Resilience Plan*
- Evaluate and retrofit dams and other water infrastructure to meet new seismic standards
- See recommended actions in the infrastructure sections of the IWRS (7.A – 7.C)

## Critical Issue – Water and Land Use

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. Policies 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 zoning and permitting 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 tools 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 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.

## Plan for Changes in Land Use

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 positioned Oregon as a nationally recognized leader in the arena of land conservation and development.[48] Changes in land use, whether to forestlands, wetlands, or other landscapes have an impact on water resources.

**Figure 3-10: Land-Use Planning Goals**

| | | |
|---|---|---|
| Process Goals | Goal 1 | Citizen Involvement |
| | Goal 2 | Land Use Planning |
| Conservation Goals | Goal 3 | Agricultural Lands |
| | Goal 4 | Forest Lands |
| | Goal 5 | Natural Resources, Scenic and Historic Areas, and Open Spaces |
| | Goal 6 | Air, Water & Land Resources Quality |
| | Goal 7 | Areas Subject to Natural Hazards |
| | Goal 8 | Recreational Needs |
| Development Goals | 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 |

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, as shown in Figure 3-10. The Land Conservation and Development Commission will acknowledge a local government's comprehensive plan when it complies with the goals. However, most acknowledged plans have not been updated with current natural resource inventory data since the 1990s.

Many of these planning goals relate to protecting and maintaining water resources, both quality and quantity. These goals provide a common sense foundation for planning and were hard fought to put into place; however, they remain only goals, often without the implementing rules or administration to back them up.

### Goal 3| Agricultural Lands

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.

Goal 3 requires the preservation of agricultural lands for farm use, consistent with the need for agricultural products, open space, and the state's agricultural land-use policy. Counties may authorize farm uses and nonfarm uses that do not have significant adverse impacts on farms or forest practices.

Agricultural land includes lands with productive soils. Classifying soils using objective metrics has been an important component of Goal 3. Soil fertility is taking into account, as well as suitability for grazing, climatic conditions, existing and future availability of water for farm irrigation purposes, existing land-use patterns, technological and energy inputs, and accepted farming practices. Planning guidelines call for buffers between urban growth and agricultural lands, as well as consideration of the "carrying capacity" of the air, land, and water resources of the planning area.

### Goal 4 | Forest Lands

Oregon's forests encompass a large part of many watersheds, particularly in the upper reaches. Forested lands 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.

Limiting land uses that could have a detrimental effect on water quality is one of the purposes of restrictive forest zoning. Development on forestlands is limited by Goal 4 and by county regulations.

### Goal 5 | Natural Resources, Scenic and Historic Areas, and Open Spaces

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 | Air, Water and Land Resources Quality

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.

Urbanization and significant new rural development on what was formerly farm or forestland may alter the stormwater regime and contribute 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 is increasingly a challenge for municipalities and for rural landowners in some areas of the state.

### Goal 7 | Areas Subject to Natural Hazards

Goal 7 directs local governments to adopt plans to keep structures above or out of floodplains and to reduce the risk to people and property from natural hazards, such as floods, landslides, earthquakes, and related hazards such as tsunamis, coastal erosion, and wildfires. This goal requires jurisdictions to apply appropriate safeguards, such as hazard overlay area zones and review standards when planning for and authorizing new development.

In addition, participation in the National Flood Insurance Program addresses the requirements of statewide planning Goal 7 with respect to flood hazards. In Oregon, 260 cities and counties and three Indian tribes participate in the program.

For several years, the National Oceanic and Atmospheric Administration Fisheries Service (NOAA-Fisheries) and the Federal Emergency Management Agency have been working together to identify measures that will reduce negative impacts from the National Flood Insurance Program on salmon, steelhead and other species listed as threatened under the Endangered Species Act (ESA). The National Marine Fisheries Services issued a Biological Opinion in April 2016, concluding that development in floodplains displaces important habitat, which fish utilize during floods, and degrades instream water quality and hydrologic conditions. The Biological Opinion includes recommendations to the Federal Emergency Management Agency for how implementation of the program could be modified to reduce its impact on ESA listed species. The Department of Land Conservation and Development has the lead state role in floodplain management, with mapping and potential impact support from the Department of Geology and Mineral Industries.

### Goal 11 | Public Facilities and Services

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.

## Plan for Population Growth in Oregon

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. Its population has tripled since 1980, now supporting more than 181,000 people, according to the U.S. Census Bureau.[49] 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 urban growth boundary to accommodate growth. Bend, for example, added 2,380 acres to its urban growth boundary in 2016 for long-term growth, and Grants Pass added 822 acres in 2014. 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.

## Integrate Water-Related Information into Land Use Planning

### Information Inputs

Considering the need to comply with several, very different land use goals, the information required 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 distribution maps, 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 maps showing municipal drinking water source area and source water assessment reports (when available) to voluntarily initiate a process to protect drinking water sources. Updated source water assessments are being completed by the Department of Environmental Quality and Oregon Health Authority and will provide improved information about the natural- and human-caused influencing conditions within source areas.

Population and employment forecasts are of interest to municipalities when estimating water demands for residential, industrial and other uses. Individual studies conducted to evaluate land use requests, particularly to show that there is an adequate supply of groundwater 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.

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.

### Underground Injection Control Systems (UICs)

Underground Injection Control systems are any manufactured design, structure, or activity that injects flow into the subsurface of the ground. The UIC program is managed by the Oregon Department of Environmental Quality, with the intent to manage stormwater, remediation of cleanup sites, industrial process waste, large onsite domestic waste, 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.

State regulations require that drinking water wells be at least 500 feet away from UICs to minimize the potential for cross contamination, but it has been difficult to ensure compliance with this requirement because information about existing UICs has been 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.

The greatest challenge to providing the public with the UIC coordinates has been that many UIC locations were submitted inaccurately with the applications. Since 2015, the Department of Environmental Quality has been going through all of its UIC files, comparing addresses to aerial photos and plotting the correct latitudes and longitudes. When this work is completed, UIC locations will be available to the public on a web-based map application. A user will be able to enter an address or a latitude and longitude and immediately see if there are UICs nearby. DEQ plans to complete this project in 2017.

### Data Gaps

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 quality and 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 those rural areas already designated as groundwater administrative 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. Benton County sanitarians have been good partners with the state, recording locations of water wells when they find them, providing maps, and outfitting wells with well identification labels.

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.

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

Examples of how to implement this action:

- Protect natural water bodies in the course of land use decisions, such as wetlands, estuaries, groundwater aquifers, rivers, and lakes
- Locate and document Underground Injection Control Systems
- Develop and share information regarding the location, quantity, and quality of water resources that can be used by local governments in land use decisions
- Improve coordination, technical guidance, and assistance to local governments for land-use decisions with regard to water
- Take next steps to implement land use goals related to water resources—establishing implementing rules, updating acknowledged plans, completing local government plans, applying appropriate safeguards during permitting
- Build partnerships with state and local governments to provide land-use information, such as tax lot information

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 water resources. Such information would help inform updates to local comprehensive plans, shovel-ready certified sites, capital improvement plans, floodplain management, and other activities that contribute to land use decisions.

Improved integration also involves sharing land use data to inform water-related decisions. For instance, counties have varied approaches for sharing tax lot information. Some counties provide this online, some charge a fee, and some do not provide this information at all.

Finding and documenting the location of water wells and improved information regarding underground injection control systems would aid community-based protection and management strategies. This information is critical to protecting drinking water sources during the course of land use decisions.

## Coordinate Between Public Agencies

Each local government responsible for land use management coordinates with various state agencies to ensure that state agency actions, such as permitting, comply with statewide planning goals and local comprehensive plans. 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.

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 the Oregon Department of Aviation and Oregon Department of State Lands have written a new State Agency Coordination Program.

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

**Recommended Action 6.B**
**Improve State Agency Coordination**

Examples of how to implement this action:

- Update State Agency Coordination Programs in partnership with the Department of Land Conservation and Development
- Design each agency permit “contingent” upon approval of all other state agency permits

## Advance Low Impact Development and Green Infrastructure

Runoff from urbanized lands and impervious surfaces such as paved streets, parking lots, and building rooftops during rainfall and snow events often contain 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. Environmental Protection Agency describes urban runoff as one of the leading sources of water quality impairment in surface waters. Urban runoff can also contaminate groundwater. Humans and their actions are the most significant sources of polluted runoff.

The U.S. Environmental Protection Agency describes low impact development and green infrastructure as generally referring to systems and practices that use or mimic natural processes to infiltrate, evapotranspire, or reuse stormwater or runoff on the site where it is generated. A common technique is the use of plants and soils to capture, slow, and filter stormwater and runoff. 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 from an impervious surface such as a roof or parking lot, a use exempt from water right permitting requirements in Oregon, is another useful approach, one that utilizes water as an on-site resource for activities like lawn watering or gardening.

### Technical Resources to Advance Low Impact Development Approaches

The Oregon Environmental Council, a non-profit organization, has partnered with the Department of Environmental Quality and others to develop a publication called *Low Impact Development in Western Oregon: a Practical Guide for Watershed Health*.[50] Published in 2016, this online manual includes both structural and non-structural design and construction ideas. For instance, it describes the use of porous pavement, rain gardens, and tree planting to mimic the flow of water in the natural landscape. It also includes a flexible template so that local jurisdictions can adapt the manual for their own climate, geology, and local setting.

The 2012 Integrated Water Resources Strategy noted that local planning departments need more technical resources and assistance in order to become familiar with low impact development techniques. The above publication helps respond to that recommendation. Additional information and resources should be compiled and maintained online, providing easy access for developers and planners.

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.

**Recommended Action 6.C**
**Encourage Low Impact Development Practices and Green Infrastructure**

Examples of how to implement this action:

- Compile and provide online information on low impact development best practices
- Update local development codes, improving local capacity to review and permit low impact development and green infrastructure designs
- Encourage communities to consider natural infrastructure in lieu of, or as a complement to, built infrastructure

**Highlight Box**

**Green Infrastructure Projects Designed to Improve Water Quality**

Green infrastructure can provide significant water quality benefits. Cities in Oregon, such as Roseburg and Forest Grove, are two such examples:

The Roseburg Urban Sanitary Authority operates a natural treatment system as part of its Roseburg Regional Water Reclamation Facility. Designed to improve water quality in the South Umpqua River, the system uses treatment wetlands, irrigation, overland flow, soil treatment, and historic natural wetlands to reduce concentrations of nitrogen and phosphorous, and to remove chlorine and heat from its wastewater. The site occupies 340 acres of farmland and the total project cost almost $10 million to implement. Funding came from user fees and a loan of $2.4 million from the Infrastructure Finance Authority. The project was presented with the 2015 Water Quality Improvement Award by the Water Environment Federation. The award is presented annually to a program that best demonstrates significant, lasting and measurable excellence in water quality improvement or in the prevention of water quality degradation in a region, basin or water body.

Similarly, the Fernhill Wetlands in Forest Grove comprises about 700 acres owned by Clean Water Services and managed in partnership with the City of Forest Grove and Fernhill Wetlands Council. The Fernhill project is creating natural treatment systems or wetlands to improve water quality by removing nutrients, cooling, and naturalizing water after conventional treatment. Ninety acres of old sewage lagoons were transformed into treatment wetlands with more than 200,000 cubic yards of soil, 15 control structures, 2,400 feet of piping, 750,000 native wetland plants, and 3.5 billion seeds. Birds and wildlife have taken to the 180 logs and snags that were anchored into place, and human visitors are flocking to enjoy the trail improvements, new outdoor classroom areas, and to watch the emerging treatment wetlands.

# Critical Issue – Water-Related Infrastructure

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 fields every day.

Irrigation-related infrastructure is a complex water delivery 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 or drainage infrastructure include:

- Storage facilities, e.g., dams and reservoirs
- Regulating reservoirs
- Wells
- Canals and pipelines
- Pumps and pumping stations
- Headgates, headworks, and valves
- Spillways, siphons, drains, penstocks, and transmission lines
- Telemetry systems
- Measurement devices
- Fish screens and fish passage facilities
- Drainage pumps, ditches, and tiles
- Levees

Agricultural producers continue to evaluate opportunities to expand operations—and irrigation in particular—to lands where soils are most amenable to water and where markets and related services are most accessible.

In the United States, drinking water is also delivered through a complex network of more than one million miles of pipes; 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.

## Use an Asset Management Approach

The approach in the utility industry is to encourage an "asset management" approach, upgrading and replacing water and wastewater infrastructure on a rolling schedule when it no longer serves its purpose. Some pieces of infrastructure no longer serve the purpose for which they were constructed. When wells or dams have significantly deteriorated, for example, the costs of repair may exceed the expected benefits, and proper decommissioning may be a less expensive alternative.

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.

The American Society of Civil Engineers (ASCE) continues to advocate for the use of an asset management approach to maintain and upgrade the nation's infrastructure. In March 2017, ASCE released its national infrastructure report card, giving the nation's infrastructure a D+, in part because of the failure to plan and fund infrastructure upgrades.[51] In Oregon, these needed investments represent tens of billions of dollars.

The ASCE promotes the use of the asset management approach because it provides decision makers with critical information about their capital infrastructure assets and the timing of their future investments. ASCE lays out four key steps for asset management, including: making an inventory of critical assets; evaluating their condition and performance; developing plans to maintain, repair and replace assets; and funding these activities.

## Support 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 agency oversight and inspection is critical to ensure wells are constructed using proper methods, materials, and equipment. Licensed and bonded water well constructors should have the equipment, knowledge, and experience required for proper well construction.

There are a number of actions that the Water Resources Department could take in order to provide more timely well inspections during construction and a more thorough review of well logs to ensure that standards are met. These include requiring a longer lead time between when a well driller files a "start card," signifying intent to construct, and when construction actually takes place. Currently, a driller may submit the start card the same day work begins. By the time the Department processes the notification, the well is often complete and the drill rig has departed the work site.

Other improvements include education and outreach to well drillers and pump installers. Doing so would help ensure that the state has accurate maps and location information about new wells; that industry professionals understand the backflow prevention requirements; and that well owners, their consultants, and agency staff have unobstructed access to measure water levels.

Along with construction requirements, any alteration, deepening, conversion or abandonment of a well must be done in accordance with groundwater laws and well construction standards. Unused wells, particularly large-diameter, open wells that are not properly decommissioned, provide avenues for contamination and are a public safety concern.

In the past ten years, Oregon has seen a number of preventable incidents due to poorly maintained and neglected wells. The incidents included animals falling into wells and needing to be rescued, children being critically injured, and an elderly woman in Douglas County dying after falling into a large-diameter well. Homeowners with old unused, neglected, or poorly maintained wells should contact the Water Resources Department for information regarding the proper methods of decommissioning their wells.

## Improve Oregon's Levees

Levees are used around the country to protect low lying areas from river flooding, coastal flooding, and other floods that are aggravated by high tides. Levees are very similar to embankment dams, in that they are generally constructed of local soils and intended to retain water without leakage or overtopping. Levees can impact riparian and floodplain functions and only provide flood protection if they are of sufficient height and stability. Even then, levees must be monitored during flooding, with leakage and overtopping identified correctly and immediately addressed. Failure of levees in some cases can be catastrophic, as was the case with Hurricane Katrina and the 2005 levee breaches in New Orleans.

Oregon has also experienced a catastrophic levee breach when a levee adjacent to the Columbia River failed, killing 15 people and destroying the City of Vanport in 1948. At the time, it was the second largest city in Oregon and the largest public housing project in the nation. The 2017 Oregon Legislature adopted Senate Concurrent Resolution 21 to commemorate the anniversary of the Vanport flood, remembering its survivors and those who lost their lives.[52]

The U.S. Army Corps of Engineers sponsors and certifies a portion of the levees in Oregon. The Corps keeps an inventory of those levees it sponsors and certifies. In exchange for assistance with inspections and emergency response, owners of those levees are required to maintain them to federal standards. These levees are well inventoried, frequently inspected and have a reasonable margin of safety. The Corps is not routinely involved in levees constructed to manage coastal (tide related) flooding.

There are other levees in Oregon that have not been maintained to federal standards, nor are they part of the Corps of Engineers certification program. Some of these other levees have been inventoried, while many have not. These levees may be in very poor condition and may need to be removed or rehabilitated. The ownership of these levees is often unclear. In some cases, landowners may be unaware that levees exist on their property or could be affected by a levee failure.

The Department of Geology and Mineral Industries is inventorying levees as resources become available. The 2015 Legislature granted the Water Resources Department the authority to work with willing owners to evaluate repair, removal, or other options for these other levees. The 2017 Legislature authorized $10 million for Business Oregon to provide financial assistance for levee projects that result in improvement, expansion, or repair and are essential for the use or development of farm, industrial, or commercial land in Oregon.

**New Standards for Levee Certification –** Levees must be accredited to be recognized in the Federal Emergency Management Agency's flood insurance program. An accredited designation means that a levee is built and maintained to protect against a one-percent-annual-chance flood event, commonly known as the 100-year flood. To achieve accreditation, a professional engineer must certify the levee. Levee failures resulting from Hurricane Katrina spurred the U.S. Army Corps of Engineers to re-evaluate their levee inspection and certification program. New evaluation standards were established in 2012 for all levee certifications, including those that were previously completed.

Several drainage districts that own and operate levees along the Columbia and Willamette Rivers near Sauvie Island are actively working on levee accreditation. In return, the districts will have access to federal floodplain insurance at a lower cost than without accreditation.

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

Examples of how to implement this action:

- Use an "asset management" approach to identify and plan for rehabilitation, upgrade, or replacement of infrastructure
- Provide timely inspection of well construction, review of well logs, and educate drillers and pump installers to ensure construction standards are met
- Inventory, inspect, and make safety improvements to levees
- Properly decommission infrastructure, such as a well, culvert, levee, or dam, at the end of its useful life

## Encourage Regional Systems

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.

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

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

Examples of how to implement this action:

- Make use of shared contracts, services, purchases
- Develop mutual assistance agreements
- Establish inter-ties and back-up supplies
- Provide incentives to encourage regional approaches

contracts, services, purchases, mutual assistance agreements, interties, and back-up supplies. State and federal agencies often provide incentives such as funding and technical assistance to encourage a regional approach to meeting water needs. Four communities are currently piloting a place-based approach to water planning that looks at water supply and demand within a basin or other hydrologic area. Some of the outcomes of those planning efforts may incorporate a more "regional" approach. For more information, refer to Chapter 4.

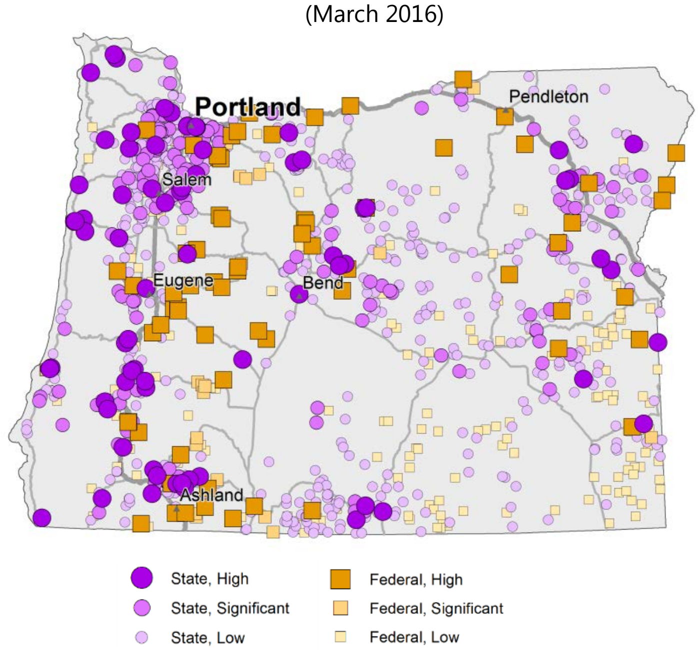
Oregon should continue providing these types of incentives, encouraging regional approaches to water and wastewater services, particularly if these approaches create efficiencies for smaller communities. Organizations such as the Oregon Association of Clean Water Agencies (ORACWA) can play a key role in making connections and encouraging regional approaches among water and wastewater systems.

## Ensure Public Safety: Oregon's Dam Safety Program

Although the concept of drinking water safety to protect human health has always been included in the Integrated Water Resources Strategy, the concept of public safety has not. In this 2017 Strategy, we bring renewed attention to dam safety, which represents a significant area in which the state has responsibility for the communities located downstream from important but aging water impoundments.

Dams are not defined in statute, but rather in rule (Oregon Administrative Rule 690-020-0022(8)). "Dam" means a hydraulic structure built above the natural ground grade line that is used to impound water. Dams include all related structures, and together are sometimes referred to as "the works." Dams can include wastewater lagoons and other hydraulic structures that store water, attenuate floods, and divert water into canals. Many traditional dams are constructed on stream channels to form reservoirs. Most dams are built of compacted soil or rock fill and are called embankment dams; a few are made of lumber. Concrete dams, although less common, are some of Oregon's largest dams. Owners of dams include homeowners, farmers, irrigation districts, private industry, municipalities, associations, and public agencies.

**Figure 3-11: Federal and State Regulated Dams**
(March 2016)




### Managing Oregon's Dam Safety Program

Oregon strives to maintain a good dam safety record to ensure public safety. The Association of State Dam Safety Officials notes that while "dams bring water, power, flood control, recreation, economic possibilities and many other advantages to people...people must understand that safe operation and maintenance is key to sustaining these advantages and avoiding potential disaster."

Oregon Revised Statutes (ORS) authorize and direct the Water Resources Department to take specific actions related to the design, construction, inspection, and safety of dams. The applicable statutes that deal directly with dam safety are ORS 540.340 to 540.400. Oregon's dam safety laws, established in 1929, are outdated, making effective actions to improve public safety very difficult. Since the last time these statutes were changed, there have been major advances in dam design, rehabilitation technology, and emergency planning standards to protect people living downstream from dams.

The State Engineer for Water Resources oversees the dam safety program and inspects all of the state-regulated high hazard dams, with one engineer to help. Among its western neighbors, Oregon has invested the lowest program dollars per dam ($365), compared to the national average of $610 per dam. Similarly, Oregon dedicates less staff per dam for inspections. Note, however, that among their many duties, Oregon's twenty-one watermasters do conduct inspections of low- and significant-hazard dams.

**Those Subject to the Dam Safety Program –** Approximately 1,200 dams in Oregon are at least 10 feet high and store 3 million gallons or more (9.2 acre-feet of water), making them subject to Oregon's dam safety program. The largest dams, however, are regulated by federal agencies. The Water Resources Department is the lead public authority responsible for 969 non-federal dams. See Figure 3-11 for a map of all large dams in Oregon.

**Hazard Ratings –** Like most states, Oregon rates dams by hazard classification—high, medium, or low. A dam's hazard rating is based on what could happen if the dam fails, not on the condition of a dam. A high hazard dam, for example, means that failure would likely cause fatalities. There are currently 75 non-federal dams rated as high hazard. These dams are inspected annually.

**Figure 3-12: Hazard Classifications for Dams**

| | |
|---|---|
| **75** | **High Hazard Dams**<br>Failure will likely cause fatalities. These dams are inspected annually. |
| **147** | **Significant Hazard Dams**<br>Failure will damage properties but loss of life is unlikely. These dams are inspected every 2 to 3 years. |
| **747** | **Low Hazard Dams**<br>Failure is unlikely to cause major property damage or loss of life. These dams are inspected every 5 to 6 years. |
| **969** | **Total Dams in the Program** |

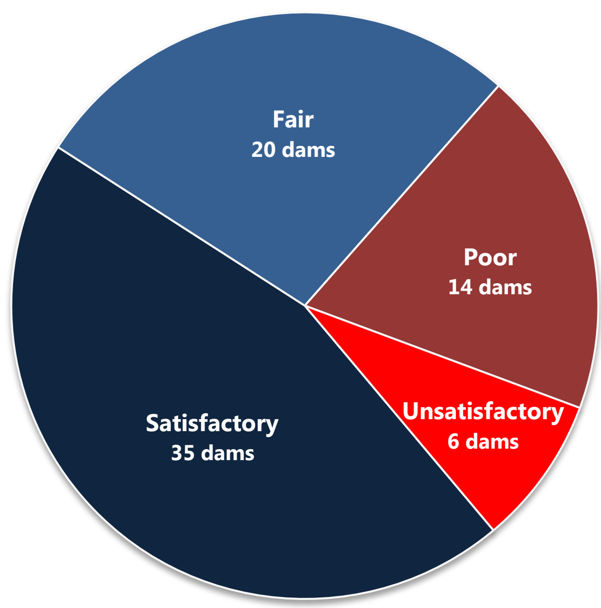
Source: OWRD, November 2017

## Safety of Dams

The original focus of Oregon's dam safety program was the review and approval of designs for new dams. A majority of Oregon's dams were constructed decades ago, with some more than 100 years old. As a result, the dam safety program now focuses on evaluating the condition of existing dams through regular inspections and providing feedback to owners regarding needed safety improvements.

High hazard dams are evaluated using four categories: satisfactory, fair, poor, and unsatisfactory. Refer to Figure 3-13 for the condition of Oregon's high hazard dams.

**Figure 3-1: High Hazard Dams by Condition [new]**




The condition analysis of each high hazard dam is updated after its formal inspection. There are no clear criteria in Oregon for determining when an unsatisfactory dam is also an unsafe dam. Some states consider all dams in unsatisfactory condition as unsafe unless there is a significant restriction in the volume of water storage allowed at that dam. Other states also consider dams in poor condition to be unsafe.

The Department works with owners to bring these dams up to current seismic safety standards. Many of Oregon's dams are old and could fail, greatly increasing the severity and consequences during major flooding. A number of pipes passing through dams have worn out as well. Additional resources are needed to determine if dams have safety or seismic deficiencies.

**Emergency Authorities –** In Oregon, if it is clear that a dam is imminently unsafe, the Department will notify the owner and schedule a hearing to see if a water level restriction or other action is deemed warranted by an administrative law judge in accordance with the dam safety statutes and Oregon administrative law. The process takes several months unless the owner voluntarily signs a consent agreement. At present, the Water Resources Department has no authority to direct an owner to take action to prevent imminent dam failure, nor can the Department take action if owners are unavailable or unwilling. If caught in time, lowering reservoir levels can reduce stress on the dam and reduce its likelihood of catastrophic failure. Other actions include bringing in pumps or siphons, using emergency rock fill, opening valves, or removing unsafe dams.

**Emergency Inspection after Extreme Events –** Oregon has no interagency agreements in place to inspect multiple dams damaged by an earthquake or widespread flood. After extreme floods and multiple dam failures in 2013 and 2015, Colorado and South Carolina had to improvise, but fortunately, both states had federal and local dam safety engineers available to make inspections quickly. In Oregon, this will be difficult after a Cascadia Earthquake or flood if access via roads is no longer possible. Dam inspections and emergency access is essential to avoid dam failures in the aftermath of a Cascadia Earthquake or significant flood. Additional arrangements are needed for effective and coordinated response during extreme events so that the public can be reassured that dams are safe, or evacuated, if necessary.

**Legal Responsibilities for Dam Safety –** The Association of State Dam Safety Officials notes that dams are a unique type of infrastructure, because while public entities tend to own roads, bridges, and sewer systems, this is not the case with dams. The majority of dams in the United States are privately owned. The Association notes that, "a dam's owner is solely responsible for the safety and liability of the dam and for financing its upkeep, upgrade, and repair." While the term "legal responsibility" of a dam owner is used in statute (ORS 540.350), it is not defined. Owners should know what their responsibilities are, including keeping the dam safe and taking immediate action if the dam begins to fail and threaten people or property.

**Monitoring High Hazard Dams –** Remote monitoring can detect a potential problem before there is harm to people and property. The most important information includes the current water level in the reservoir and any change in seepage flow through the dam. A few dam owners are already collecting and analyzing this information now, as it allows them to improve the performance and safety of their dams. Other owners do not monitor their dams. The Water Resources Department is not authorized to require monitoring on high hazard dams, even those in poor or unsatisfactory condition.

**Emergency Action Plans –** An Emergency Action Plan (EAP) helps identify situations where a dam failure might occur, and spells out actions that could save the dam and hasten evacuations. Approximately 75 percent of state-regulated high hazard dams have EAPs. The 2017 Legislature passed a bill requiring owners or operators of high-hazard dams to develop an emergency action plan and file it with the Water Resources Department, Office of Emergency Management, and the local county emergency agency no later than January 1, 2019.

**Review of Preliminary Plans and Specifications –** The first step to developing a safe dam and sound reservoir is a site feasibility evaluation. This evaluation is then used for the next step of developing preliminary plans and specifications for a dam. In other states, early review of preliminary plans and specifications is a typical responsibility of state government. Currently, however, Oregon has neither resources nor standards for an early review of preliminary plans and specifications. In the past, some dams have been designed and sometimes built without addressing these critical first steps, only to require expensive rehabilitation or removal at a later date.

Feasibility evaluations should clarify the owners' objectives; evaluate water supply and flows, identify poor rock or soils, landslides and faults; and evaluate potential fish, aquatic and water quality issues. If the dam is feasible, the best site and height are determined. Preliminary plans and specifications include a summary report with drawings showing the dam location, height, and anticipated location of a spillway conduit, and where needed, provisions for fish and water quality. These plans are an early version of the design and help focus on what is needed to construct a safe, functional, and protective reservoir.

Improved ability for the Department to conduct more timely reviews and to correspond with engineers from preliminary to final design would result in more certainty and consistency for dam owners and project engineers.

**Grant and Loan Programs –** Most conventional loan programs cannot be applied to dam repair or maintenance, and since many dams are privately owned, many owners do not have the financial resources necessary to rehabilitate their dams. This is especially true for dams that generate no income. It is essential to inspect, monitor and analyze those dams with known deficiencies. With older dams, there are often a great number of unknowns, uncertainties, and defects, including the reliability or existence of design information.

Recently, the dam safety program and other grant programs provided some funds to dam owners to conduct structural analysis of high hazard dams.

Although Oregon has efficiently leveraged limited resources to improve the overall safety of state-regulated dams, many important activities have been deferred, some indefinitely. Establishing formal grant and loan programs would allow owners to make seismic upgrades, rehabilitate unsafe dams that still have value, or to provide funds for removal of dams that no longer provide benefits.

Congress signed the Water Infrastructure Improvements for the Nation (WIIN) Act into law in 2016, authorizing a national dam rehabilitation and repair program.[53] The goal is to help dam owners implement needed repairs and upgrades. However, this program has not yet been funded. Similarly, the federal National Dam Safety Program was reauthorized by Congress as part of the Water Resources Reform and Development Act (WRRDA) in 2014; this program also has not received its full appropriation at authorized levels.[54]

**Recommended Action 7.C**
**Ensure Public Safety / Dam Safety**

Examples of how to implement this action:

- Modernize state laws to improve the safety and resiliency of Oregon dams
- Authorize resources to determine if dams have safety deficiencies; evaluate and retrofit dams to meet new seismic standards
- Authorize emergency actions and encourage cooperative actions to improve the safety of dams
- Properly decommission dams at the end of their useful life.
- Coordinate interagency emergency responses regarding dam inspection, communication, and evacuation
- Define the legal responsibilities of a dam owner
- Authorize a requirement for remote monitoring on deficient high hazard dams
- Dam owners should prepare and implement an Emergency Action Plan for all existing dams rated high hazard
- Authorize a fee for review of plans and specifications
- Dedicate grant and loan resources for rehabilitation of deficient dams

# Critical Issue – Education and Outreach

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. Often, 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.

## Support Oregon’s K-12 Environmental Literacy Plan

### Environmental Literacy

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.

Finalized in October 2010, the Environmental Literacy Plan 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. 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 natural resources in the future. Under this Plan, students graduating from high school should be environmentally literate.

In 2014, Oregon State University became the administrative body overseeing the state’s Environmental Literacy Program to help implement the plan. The program supports K-12 teachers by providing professional development training, conducting research and assessment, maintaining a database of resources, and building capacity through partnerships.

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

Examples of how to implement this action:

- Support implementation of the Environmental Literacy Plan
- Natural resource agencies, community organizations, and others should engage in education for environmental literacy activities

Fortunately, high quality, water-related curricula already exists for K-12 educators. 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.

### Outdoor School

Oregon State University will also serve in a leadership role for Oregon's "Outdoor School" program, a week-long field science curriculum for fifth and sixth graders, focusing on the environment, natural resources, economic development, and related careers. Since the late 1950s, nearly one million students have participated, studying natural sciences and the responsible use of natural resources with students from other schools. Participation in Outdoor School varies by school district and has not been available on a statewide basis. Ballot Measure 99 was passed in 2016 by voters, creating an Outdoor School Education Fund with four percent of funding coming from Oregon State Lottery money—up to $22 million—with the stipulation that these efforts cannot reduce lottery proceeds dedicated to the restoration and preservation of parks, beaches, watersheds, and native fish and wildlife.[55]

### Children's Clean Water Festival

The Children's Clean Water Festival, held in the Portland metro area, 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 fourth and fifth grade students 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. The 2017 Clean Water Festival marks the 24th year of the event with more than 30,000 students participating since its inception. Several partnering agencies provide financial and staff time, with more than 125 classroom presenters, exhibitors, and community members volunteering annually at the event.

**Figure 3-14: Children's Clean Water Festival**

Staff from the Water Resources Department gave a groundwater demonstration to students at the Children's 2016 Clean Water Festival.

## Educate 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 Research Foundation and the American Water Works Association published a report in 2010 that summarizes previous studies on the workforce issues facing the water sector. Studies estimate that there could be a loss of 30 to 50 percent of water utility employees in the next 10 years, due to retirement, with the greatest impact on engineering and operations. With this comes a loss of institutional knowledge, as retirees exit the workforce.[56]

Add to this a 2003 Congressional Budget Office study that noted 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 concern 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 May 2010 issue of the journal *Science*, 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.

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 and geologists 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.

Hydrogeologists 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 in Albany and Clackamas Community College in 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.

Nationally, there are numerous professional societies that support the water sector industry by offering special workshops, conferences, continuing education opportunities, and access to the latest research. Several local chapters exist in Oregon and cover a wide range of disciplines, such as groundwater, wastewater, and drinking water, for example.

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

Examples of how to implement this action:

- Determine whether career training programs are available and equipped to meet the coming demand for water professionals
- Offer job shadow programs to expose students to careers in water
- Continue funding support for water-related trade programs at Oregon community colleges

Only one community college, Lane Community College in Eugene, offers 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 processing records for use.

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 Office of Community Colleges and Workforce Development also provides a listing of colleges that offer water-related courses, degrees, and programs throughout Oregon.

## Provide Community-Based Education and Outreach

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 locally-led education and outreach efforts. Oregon should continue providing technical training to soil and water conservation districts, watershed councils, and other on-the-ground organizations.

Federal agencies, such as the U.S. Environmental Protection Agency and the U.S. Geological Survey also have water-related resources available for education. Many local water providers, watershed councils, and non-profit organizations in Oregon have also developed their own educational and outreach materials, making them available to the public.

State agencies will also need to play a role in community-based education and outreach. Oregon needs an accessible, outward facing communications platform for sharing water information and trends. The Water Resources Department is best suited to fulfill this role and could develop an educational series on a variety of topics, such as water rights, funding opportunities, best practices, and new technology. More broadly, agencies can help express the importance of water needs in each sector and the value of collaborative decision-making in resolving conflicts.

Some other examples of education and outreach opportunities that should be promoted by a variety of partners include:

- Farm-to-farm tours to demonstrate water conservation and efficiency techniques
- Improving stewardship by connecting Oregonians to the outdoors
- Domestic well stewardship: proper installation and maintenance of domestic wells, wellhead protection, testing wells for contaminants, interpreting the results, addressing any contaminants
- Proper care/maintenance for septic systems
- Graywater use systems
- Rainwater harvesting systems
- Pharmaceutical take back programs, hazardous waste collection events
- Streamflow restoration programs, such as the allocation of conserved water program and instream transfers or leases

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.

Another example is the Oregon State Marine Board, which offers numerous environmental and recreation-based boating safety programs, often partnering with other agencies such as the Department of Fish and Wildlife and Parks and Recreation Department. Some of these programs include:

- Water Wits, a K-12 curriculum with interactive lessons in boating, water safety and marine stewardship
- Interactive Boat Oregon Map of public boating access facilities and other important data layers. This includes launch ramps, boating obstructions, Certified Clean Marinas, pumpouts and floating restrooms, clear gasoline locations, rivers where personal watercraft (e.g. jets skis) are allowed, boating regulations and boating waterways
- Information on boating obstructions, found at www.boatoregon.com/obstructions. This information is verified and mitigated (where possible) by marine law enforcement
- Nationally accredited boater education courses
- Free online paddling education and promotion of Oregon Water Trails

The Oregon State Marine Board also conducts outreach and education through the Aquatic Invasive Species Prevention Permit, Clean Marina and Clean Boater programs. These recreation-based outreach and education programs should be promoted and encouraged in Oregon.

**Recommended Action 8.C**
**Promote Community Education and Training Opportunities**

Examples of how to implement this action:

- Look for opportunities to keep the general public informed about the importance of water resources
- Look for opportunities to provide outreach about streamflow restoration, water conservation, transfers, and other programs and tools
- Promote technical training for public and private partners
- Promote access to water-related recreational opportunities through the use of state programs

## 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 universities, research institutions, and other partners.

Several state and federal agencies offer internship programs for students to gain real-world experience and exposure to day-to-day operations. Business Oregon, for example, has an internship program that includes work in clean technology and renewable energy. Other agencies – the Department of Fish and Wildlife, Department of Forestry, and Water Resources Department – often provide summer internships or seasonal employment opportunities to support monitoring and assessment projects, or other field-based activities. Local agencies, such as water providers, are key partners in research, helping to bring science into practice.

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

Examples of how to implement this action:

- Continue to identify ongoing research needs at the local and state level
- Partner with public and private institutions to address research needs
- Participate in research initiatives

Students in these internships have a unique opportunity to seek out both theoretical and applied research questions. They can take these questions back to their undergraduate or graduate programs and use them as the basis for their own original research and publication.

## Recommended Actions at a Glance

| Critical Issue | Recommended Action |
|---|---|
| Water and Energy | 4.A Analyze the Effects on Water from Energy Development Projects and Policies<br>4.B Take Advantage of Existing Infrastructure to Develop Non-Traditional Hydroelectric Power<br>4.C Promote Strategies That Increase/Integrate Energy and Water Savings |
| Climate Change | 5.A Support Continued Basin-Scale Climate Change Research Efforts<br>5.B Assist with Climate Change Adaptation and Resiliency Strategies |
| Extreme Events | 5.5A Plan and Prepare for Drought Resiliency<br>5.5B Plan and Prepare for Flood Events<br>5.5C Plan and Prepare for Cascadia Subduction Earthquake Event |
| Water and Land Use | 6.A Improve Integration of Water Information into Land Use Planning (& Vice-Versa)<br>6.B Improve State Agency Coordination<br>6.C Encourage Low Impact Development Practices and Green Infrastructure |
| Water-Related Infrastructure | 7.A Develop and Upgrade Water and Wastewater Infrastructure<br>7.B Encourage Regional (Sub-Basin) Approaches to Water and Wastewater Systems<br>7.C Ensure Public Safety / Dam Safety |
| Education and Outreach | 8.A Support Implementation of Oregon's K-12 Environmental Literacy Plan<br>8.B Provide Education and Training for Oregon's Next Generation of Water Experts<br>8.C Promote Community Education and Training Opportunities<br>8.D Identify Ongoing Water-Related Research Needs |

# References

[1] U.S. Department of Energy. 2014. The Water-Energy Nexus: Challenges and Opportunities. Washington, D.C. https://energy.gov/sites/prod/files/2014/07/f17/Water%20Energy%20Nexus%20Full%20Report%20July%202014.pdf

[2] Northwest Power and Conservation Council. 2016. Seventh Power Plan. https://www.nwcouncil.org/energy/powerplan/7/plan/

[3] Oregon Department of Energy. 2017. Facilities under the Energy Facilities Siting Council. Salem, Oregon. http://www.oregon.gov/energy/facilities-safety/facilities/Pages/Facilities-Under-EFSC.aspx

[4] Northwest Power and Conservation Council. 2014. Columbia River Basin Program.

[5] Oregon Legislature. 2013. Senate Bill 837. https://olis.leg.state.or.us/liz/2013R1/Downloads/MeasureDocument/SB837

[6] Oregon Association of Clean Water Agencies. 2017. ACWA Awards Webpage. http://www.oracwa.org/a-acwa-awards.html

[7] Oregon Department of Consumer and Business Services, Building Codes Division. 2017. Adopted Codes Online. https://www.oregon.gov/bcd/codes-stand/Pages/adopted-codes.aspx

[8] Oregon Department of Consumer and Business Services, building Codes Division. 2017. Statewide Alternate Methods. https://www.oregon.gov/bcd/codes-stand/Pages/alternate-methods.aspx

[9] Oregon Department of Consumer and Business Services, Building Codes Division. 2017. Reach Program. https://www.oregon.gov/bcd/codes-stand/Pages/reach.aspx and http://www.oregon.gov/bcd/Documents/brochures/3660.pdf.

[10] Oregon Department of Agriculture. 2013. Oregon State of the Agriculture Industry Report. http://library.state.or.us/repository/2009/200903310943442/2013.pdf

[11] Intergovernmental Panel on Climate Change. 2014. Climate Change 2014 Synthesis Report for Policy Makers. http://www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_SPM.pdf

[12] Weber, Jeffrey. 2010. Climate Change Adaptation Framework for the State of Oregon. Department of Land Conservation and Development. Salem, Oregon. https://www.oregon.gov/LCD/docs/climatechange/framework_summary.pdf.

[13] Weber, Jeffrey. 2014. Regional Framework for Climate Adaptation—Clatsop and Tillamook Counties. Department of Land Conservation and Development. Salem, Oregon. https://www.oregon.gov/LCD/OCMP/docs/Publications/Regional_Framework_Adapt_Clat_Till.pdf.

[14] Oregon Legislature. 2007. House Bill 3543. Salem, Oregon. https://olis.leg.state.or.us/liz/2007R1/Downloads/MeasureDocument/HB3543/Enrolled.

[15] Oregon Global Warming Commission. 2017. Biennial Report to the Legislature. Salem, Oregon. http://www.keeporegoncool.org/sites/default/files/ogwc-standard documents/OGWC%202017%20Biennial%20Report%20to%20the%20Legislature_final.pdf

[16] National Oceanic Atmospheric Association. 2016. State of the Climate: Global Analysis for November 2016. NOAA National Centers for Environmental Information.

[17] Dalton, M.M., K.D. Dello, L. Hawkins, P.W. Mote, and D.E. Rupp. 2017. The Third Oregon Climate Assessment Report, Oregon Climate Change Research Institute, College of Earth, Ocean and Atmospheric Sciences, Oregon State University, Corvallis, Oregon. http://www.occri.net/publications-and-reports/third-oregon-climate-assessment-report-2017/

[18] Hamlet, A. F., M. M. Elsner, G. S. Mauger, S.-Y. Lee, I. Tohver, and R. A. Norheim. 2013. An Overview of the Columbia Basin Climate Change Scenarios Project: Approach, Methods, and Summary of Key Results." Atmosphere-Ocean 51 (4): 392-415. doi: 10.1080/07055900.2013.819555.

[19] Elsner, M. M., L. Cuo, N. Voisin, J. S. Deems, A. F. Hamlet, J. A. Vano, K. E. B. Mickelson, S. Lee and D. P. Lettenmaier. 2010. Implications of 21st Century Climate Change for the Hydrology of Washington, State. Climatic Change 102: 225-260. doi: 10.1007/s10584-010-9855-0.

[20] Fischer, G., M. Shah, and H. van Velthuizen. 2002. Impacts of Climate on Agro-Ecology. In Climate Change and Agricultural Vulnerability, 38–91. Vienna, Austria: IIASA.

[21] Westerling AL. 2016. Increasing western U.S. forest wildfire activity: sensitivity to changes in the timing of spring. Phil. Trans. R. Soc. B 371(1696): 20150178. DOI: 10.1098/rstb.2015.0178.

[22] Mantua, N., I.Tohver, and A. Hamlet. 2010. Climate Change Impacts on Streamflow Extremes and Summertime Stream Temperature and Their Possible Consequences for Freshwater Salmon Habitat in Washington State. Climatic Change 102 (1): 187-223. doi: 10.1007/s10584-010-9845-2. (Note: as cited in the 2013 Oregon Climate Assessment Report, "Climate Change in the Northwest.")

[23] Isaak, D. J., C. C. Muhlfeld, A. S. Todd, R. Al-Chokhachy, J. Roberts, J. L. Kershner, K. D. Fausch, and S. W. Hostetler. 2012. The Past as Prelude to the Future for Understanding 21st-Century Climate Effects on Rocky Mountain Trout. Fisheries 37 (12): 542-556. doi: 10.1080/03632415.2012.742808. (Note: as cited in the 2013 Oregon Climate Assessment Report, "Climate Change in the Northwest.")

[24] Oregon Health Authority. 2017. Oregon Climate and Health Resilience Plan. https://public.health.oregon.gov/HealthyEnvironments/climatechange/Pages/resilience-plan.aspx

[25] Whitely Binder, L.C. and J. Jurjevich. Winds of Change? Exploring Climate Change-Driven Migration and Related Impacts in the Pacific Northwest. (2016). Portland, Oregon: Portland State University Population Research Center (Portland, Oregon) and the University of Washington Climate Impacts Group (Seattle, Washington). http://pdxscholar.library.pdx.edu/cgi/viewcontent.cgi?article=1037&context=prc_pub&utm_content=buffer02628&utm_medium=social&utm_source=twitter.com&utm_campaign=buffer

[26] Oregon Water Resources Department. 2017. Oregon Water Conditions Report for September 5, 2017

[27] Brown, Governor Kate. 2015. Executive Order 15-09: Directing State Agencies to Plan for Resiliency to Drought, to Meet the Challenge that a Changing Climate Brings. Salem, Oregon. https://www.oregon.gov/gov/Documents/executive_orders/eo_15-09.pdf

[28] Oregon Office of Emergency Management and Water Resources Department. 2016. Drought Annex: State of Oregon Emergency Operations Plan. Salem, Oregon. http://www.oregon.gov/owrd/WR/docs/OR%20EOP_2015_IA%2001%20drought(2).pdf

[29] Wisler E. 2016. Drought and Oregon's Outdoor Recreation. The Climate Circulator. https://climatecirculatororg.wordpress.com/2016/06/22/drought-and-oregons-outdoor-recreation/

[30] Stevenson, John. 2016. Documenting the Drought. The Climate Circulator. https://climatecirculatororg.wordpress.com/2016/05/24/documenting-the-drought/

[31] U.S. Department of Agriculture's National Agricultural Statistics Service. July 6, 2015. Oregon Crop Progress and Condition. https://www.nass.usda.gov/Statistics_by_State/Idaho/Publications/Crop_Progress_&_Condition/2015/CW0414.pdf

[32] Stevenson, John. 2016. Documenting the Drought. The Climate Circulator. https://climatecirculatororg.wordpress.com/2016/05/24/documenting-the-drought/

[33] Stevenson, John. Success Stories. Agriculture Climate Network. 2015. https://www.agclimate.net/success-stories/

[34] See USDA, above.

[35] U.S. Department of Agriculture. 2016. Narrative Timeline of the Pacific Northwest Wildfire Season. https://wfmrda.nwcg.gov/docs/_Reference_Materials/2015_Timeline_PNW_Season_FINAL.pdf

[36] Oregon Legislative Fiscal Office. 2016. 2015 Fire Season Costs – Budget Information Brief. http://www.oregon.gov/ODF/Board/Documents/FireProgramReview/LFO%202015%20Fire%20Season%20Costs.pdf

[37] Washington State Department of Agriculture. 2015 Drought and Agriculture. 2017. AGR PUB 104-495 (N/2/17). http://agr.wa.gov/FP/Pubs/docs/495-2015DroughtReport.pdf

[38] Drought Task Force. 2016. Report of the Task Force on Drought Emergency Response. Salem, Oregon. https://www.oregon.gov/owrd/docs/HB4113/Draft_Final_Task_Force_Report_11_1_2016_Final.pdf

[39] IWRS Policy Advisory Group. 2017. Final Report. Salem, Oregon. http://www.oregon.gov/owrd/LAW/docs/IWRS/PAG%20Memo%20to%20the%20%20Water%20Resources%20Commission_Final.pdf

[40] National Institute of Building Sciences' Multi-Hazard Mitigation Council. 2005. Natural Mitigation Saves: an Independent Study to Assess the Future Savings from Mitigation Activities. Washington, D.C. https://c.ymcdn.com/sites/www.nibs.org/resource/resmgr/MMC/hms_vol1.pdf.

[41] Oregon Department of Land Conservation and Development. 2015. Oregon Natural Hazards Mitigation Plan. https://www.oregon.gov/LCD/HAZ/docs/2015ORNHMP/2015ORNHMPApproved/Approved_2015ORNHMP.pdf

[42] Colorado Department of Natural Resources. 2013. *Drought Mitigation and Response Plan. Denver, Colorado.* http://cwcb.state.co.us/water-management/drought/documents/statedroughtmitplan2013/coloradodroughtmitigationresponseplan2013.pdf

[43] Taylor, George and Raymond R. Hatton. 1999. The Oregon Weather Book: A State of Extremes. Corvallis: Oregon State University.

[44] National Oceanic and Atmospheric Association. 2015. *What Are Atmospheric Rivers?* http://www.noaa.gov/stories/what-are-atmospheric-rivers

[45] Rupp, David E., and Sihan Li. 2016. Less warming projected during heavy winter precipitation in the Cascades and Sierra Nevada. International Journal of Climatology.

[46] National Oceanic and Atmospheric Administration's Earth System Research Laboratory. 2017. Notable Atmospheric River Events. https://www.esrl.noaa.gov/psd/atmrivers/events/

[47] Oregon Seismic Safety Policy Advisory Commission. 2013. The Oregon Resilience Plan Executive Summary. https://www.oregon.gov/OMD/OEM/osspac/docs/Oregon_Resilience_Plan_Executive_Summary_Final.pdf

[48] Oregon Legislature. 1973. Senate Bill 100. https://www.oregon.gov/LCD/docs/bills/sb100.pdf.

[49] United States Census Bureau. 2016. Quick Facts for Deschutes County. Accessed March 23, 2017. https://www.census.gov/quickfacts/table/PST045215/41017

[50] Oregon Environmental Council et al. 2016. Low Impact Development in Western Oregon: a Practical Guide for Watershed Health. http://www.oregon.gov/deq/wq/tmdls/Pages/TMDLs-LID.aspx.

[51] American Society of Civil Engineers. 2017. Infrastructure Report Card. http://www.infrastructurereportcard.org/

[52] Oregon Legislature. 2017. Senate Concurrent Resolution 21. https://olis.leg.state.or.us/liz/2017R1/Downloads/MeasureDocument/SCR21/Introduced.

[53] U.S. Congress. 2016. Water Infrastructure Improvements for the Nation (WIIN) Act. https://www.congress.gov/bill/114th-congress/senate-bill/612/text

[54] U.S. Congress. 2014. Water Resources Reform and Development Act (WRRDA). https://www.govtrack.us/congress/bills/113/hr3080/text

[55] People of the State of Oregon. 2016. Measure 99: Outdoor School Lottery Fund *Initiative*. https://ballotpedia.org/Oregon_Outdoor_School_Lottery_Fund,_Measure_99_(2016)

[56] Water Research Foundation and American Water Works Association. 2010. Water Sector Workforce Initiative. http://www.waterrf.org/publicreportlibrary/4206.pdf

# CHAPTER 4

## Meet Instream and Out-of-Stream Needs

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 require adequate funding.

**Quick Links to Main Sections:**

# Critical Issue – Place-Based Efforts

The 2012 Strategy specifically called for the state to create a statewide framework for developing place-based integrated water resources plans. The Water Resources Department researched how other states encourage and support integrated water planning at the local level and also gathered feedback through a series of public workshops, interagency meetings, and other venues. This research and feedback were used to develop a set of draft planning guidelines that outline how communities can undertake place-based planning.

The 2015 Draft Planning Guidelines (Guidelines) present a framework for Oregonians to plan for their water future.[1] The Guidelines include key planning principles as well as five planning steps:

- **Step 1** – Build a collaborative and inclusive process with diverse water interests
- **Step 2** – Gather information to characterize water resources and identify knowledge gaps
- **Step 3** – Examine current and future instream and out-of-stream water needs
- **Step 4** – Develop and prioritize strategic, integrated solutions to meet multiple water needs
- **Step 5** – Create and approve a local, integrated water resources plan

**Figure 4-1: Key Place-Based Planning Principles**

- Locally-initiated and led collaborative process
- Voluntary, non-regulatory approach
- Includes a balanced representation of water interests
- Conducted in partnership with the state
- Addresses instream and out-of-stream needs, including water quantity, quality and ecosystem needs
- Utilizes an open and transparent process that fosters public participation
- Facilitates implementation of local solutions
- Builds on and integrates existing studies and plans
- Does not jeopardize existing water rights
- Recognizes the public interest in water
- Consistent with the principles in the Integrated Water Resources Strategy, and state laws and policy

### Legislation

In 2015, the Oregon Legislature supported place-based approaches to water planning by giving the Water Resources Department authority to issue grants, enter into contracts or agreements, and provide technical assistance to support development of local strategies and solutions.

According to the legislation (Senate Bill 266)[2], place-based integrated water resources strategies must:

- Be developed in collaboration with a balanced representation of interests
- Balance current and future instream and out-of-stream needs
- Include the development of actions that are consistent with the existing state laws concerning the water resources of this state and state water resources policy
- Facilitate implementation of local solutions
- Be developed utilizing an open and transparent process that fosters public participation
- Be developed in consultation with the (Water Resources) Department

### Providing Financial Assistance to Communities

The 2015 Legislature allocated $750,000 to the Water Resources Department to assist communities with planning. The authority to provide grants to support place-based planning is currently set to expire in 2019.

In late 2015, the Water Resources Department solicited letters of interest from communities that wanted to undertake collaborative water planning using the place-based planning framework. More than 80 individuals and organizations responded with inquiries, and by the end of the two-month solicitation period, 16 communities had submitted letters of interest requesting more than $3.6 million.  Four places were selected to receive grants, with two communities receiving the full amount requested and two communities receiving partial funding.  These communities have been able to leverage this funding to pursue significant in-kind and cash contributions greater than the state's original investment.

### Providing Technical Assistance to Communities

In addition to financial support, state agencies are providing technical assistance to the planning groups.  The state hired two coordinators to support planning groups by: administering funding; offering guidance; connecting the planning groups to information, expertise, and resources; coordinating technical assistance from the Department; and serving as a partner in the planning process.

Multiple state natural resources agencies – primarily Water Resources, Fish and Wildlife, Agriculture, and Environmental Quality – are contributing their time and resources to the planning efforts and working to better integrate agency efforts at the local level.

Bringing together state agencies and local partners through planning creates a testing ground for the wide range of recommended actions described in 2017 Integrated Water Resources Strategy.  From land-use practices to natural resources management and emergency preparedness, communities are well positioned to build trust, hold difficult conversations, and make progress on issues beyond what state agencies can do on their own.

Place-based planning has improved inter- and intra-agency coordination and has improved access to agency data and information.  It has also created venues to share local knowledge and agency expertise about water issues.  Continued investments in technical assistance are critical to ensure agencies can partner with communities and provide ongoing support.

### Communities Undertaking Place-Based Planning

The four communities that received financial assistance to test the Draft Planning Guidelines are:

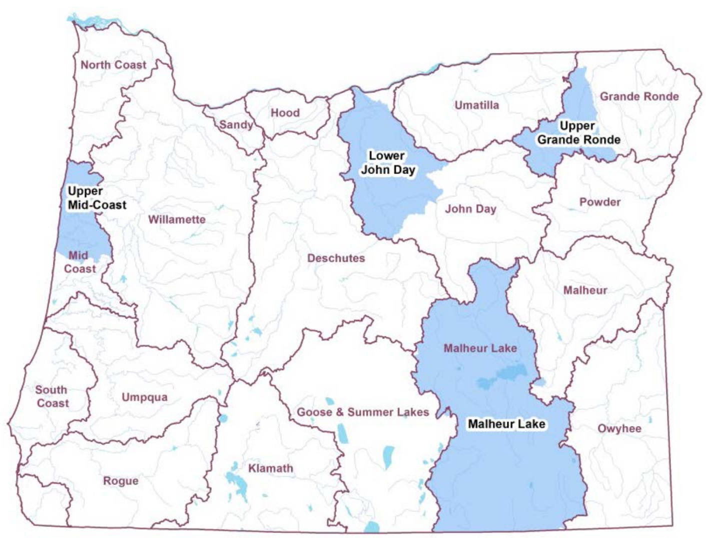
**Upper Grande Ronde River Sub-Basin –**
Convened by Union County

**Lower John Day River Sub-Basin –**
Co-convened by the Gilliam Soil and Water Conservation District and the Mid-John Day Bridge Creek Watershed Council

**Malheur Lake Basin –**
Co-convened by the Harney County Watershed Council and the Harney County Court

**Mid-Coast Region –**
Co-convened by the City of Newport and the Water Resources Department

**Figure 4-2:  Place-Based Planning Areas**




Consistent with the spirit of a place-based approach, the planning process and plans will look different for each place.  All four communities face unique water challenges, are convened by different entities, and have diverse partners that see the spectrum of water needs in their watersheds differently.  Using the state's planning framework, all of the groups have brought together individuals and organizations representing instream interests (such as fish and wildlife needs and recreation), out-of-stream interests (such as agriculture, municipalities, domestic, industry), as well as representatives from local, state, federal, and tribal governments.

These planning groups, in partnership with the state, are building their capacity to collaboratively solve water problems, improve coordination of existing information and plans, foster partnerships among different water sectors and water users, leverage public and private investments to maximize impact, engage the broader public in community conversations about water, and encourage continuous improvements in water planning and management. Place-based planning can help Oregon communities identify and develop widely supported project concepts that can meet multiple needs. Projects that are collaboratively developed and that yield social, economic, and environmental benefits will have a competitive edge for implementation funding.

### Challenges Faced by Oregon Communities

Although any community is welcome to use the Draft Planning Guidelines and pursue a place-based approach to water planning, a recent survey found that communities face a number of challenges in doing so. Of the places that did not receive financial support from the state, all of them continue to express an interest in and need for collaborative water planning. The need has been intensified by consecutive years of drought, recent floods, heavy snow, wildfires, and a greater recognition of aging infrastructure. Despite sustained interest, there are four primary challenges that hinder communities from initiating place-based planning:

**Limited funding –** It is difficult to find and secure sufficient funding to sustain a multi-year collaborative planning effort.

**Limited coordination capacity –** Bringing people together and making sure they are coordinated requires a significant institutional investment and not every organization has the capacity without additional support.

**Too many competing demands –** Local leaders are pulled in many directions responding to different competing needs in their communities. Water planning is one of many priority issues that require attention.

**Lack of information or knowledge –** Some areas still lack critical data and information, which limits our ability to understand and address complex problems. Although there may be multiple sources of information, it can be challenging to access and interpret available data and information.

### Actions for the Next Five Years

The communities currently piloting place-based planning should be supported in various ways to achieve successful outcomes and implementation of practical, local solutions. Having access to professional facilitation, increasing access to financial and technical resources, and creating peer-to-peer learning opportunities are already emerging as lessons learned and best practices.

As planning progresses, the Department and its partners will gain valuable insights from these first efforts. The state should review and update the planning guidelines to reflect what has been learned and share with other interested communities and stakeholders.

The state should research how other states across the nation, as well as other countries, support integrated water resources planning at the local level and how that differs from Oregon's approach. The state should also seek to better understand the challenges and barriers that communities face in planning for their water future and continue to engage communities beyond the current planning areas that would like to develop a plan but lack

**Recommended Action 9.A**
**Continue to Undertake Place-Based Integrated Water Resources Planning**

Examples of how to implement this action:

- Promote success by continuing to support the places currently following the draft planning guidelines
- Continue to provide financial and technical assistance to support collaborative water planning
- Promote peer-to-peer learning between communities pursuing collaborative water planning
- Assess and review efforts thus far, soliciting input on place-based planning, refining planning guidelines, and implementing process improvements

the necessary resources. Planning groups should continue to actively provide input and feedback to statewide leaders about how the state can support them in their planning efforts.

Over the next five years, public and private partners should continue to play an active role in shaping a place-based approach to water planning. In order to succeed, place-based planning must be championed by local leaders and supported by instream and out-of-stream interests across the state. It will require new partnerships, creative approaches to problem-solving, a continued commitment to improved coordination and integration, and sustained investments from the public and private sectors. In November 2017 the Meyer Memorial Trust granted two communities, the Mid-Coast and Harney County, $120,000 each for an additional year of place-based planning.

## Coordinate 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.

Within a basin or sub-basin, multiple planning documents that involve water management, directly or indirectly, may exist. These plans may be contradictory or complementary. Coordination of these plans could lead to improved collaboration, resulting is greater benefits for natural resources.

Water management and conservation plans (by a municipal water provider, or irrigation district); fish conservation and recovery plans; biological opinions; basin plans for water allocation; Total Maximum Daily Load plans for improving water quality; water system master plans; 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 large number 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.

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

Examples of how to implement this action:

- Coordinate and reconcile existing planning documents
- Dedicate resources for state and local implementation of existing plans

In envisioning a place-based approach to water planning, 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. To assist, the state should dedicate resources for implementing actions contained in existing planning documents.

## Partner 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's management of water resources. 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 information sharing are just a few areas where new partnerships can benefit water planning and management.

### 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 resources management, land management, and therefore, water resources management is significant. State and federal agencies often work together on cooperative studies, such as groundwater basin studies, discussed in Chapter 1.

Another example is the use of federal Biological Opinions. Watersheds throughout Oregon are host to a number of threatened, endangered, and sensitive species. Biological Opinions set objectives for species protection by laying out actions to protect, enhance, or restore conditions for these species and their habitat. Several federal and state agencies participate in the Willamette Action Team for Ecosystem Restoration to carry out and coordinate actions in the 2008 Willamette Biological Opinions.

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 management of critical pieces of water infrastructure, among them, federal reservoirs that store water for patrons of irrigation districts 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 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 legal government-to-government relationship with tribes through both executive action and legislation.

With regard to water, these relationships often revolve around cultural and natural resource 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 address federal reserved 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*.[3] 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 the border can manage the resource effectively.

Oregon should continue to work with neighboring states to ensure sustainable management of surface water and groundwater resources.

Oregon has been engaged in discussions with the State of Washington to pursue opportunities that include potential long-term investment partnerships to construct new above-and below-ground storage facilities. Discussions could also include coordinated permitting and regulatory approaches, and the protection of streamflow across state boundaries.

### United States, Canada, and Tribes: Columbia River Management

The Columbia River Treaty between the United States and Canada was ratified in 1964, bringing significant management efforts for flood control and power generation benefits to both countries. The year 2024 marks the end of pre-paid flood control space from Canada. Either Canada or the United States can provide notice to renegotiate provisions of the Treaty up to complete termination, with a minimum of 10 years written advance notice, making 2014 an 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, conducted a multi-year effort to study these post-2024 Treaty issues. This effort was called the 2014/2024 Columbia River Treaty Review. Stakeholders embarked on a campaign to elevate the subjects of water supply and ecosystem needs into the top tier of discussion items. Those issues were included in the *U.S Entity Regional Recommendations for the Future of the Columbia River Treaty after 2024*, which recommended that the United States pursue a number of modifications to the Columbia River Treaty, along with some unresolved domestic matters.[4] The U.S. Department of State is now leading efforts for updating the Columbia River Treaty.

In a separate but parallel process, the U.S. Army Corps of Engineers, Bonneville Power Administration, and Bureau of Reclamation (or Action Agencies) are working to prepare an Environmental Impact Statement under the National Environmental Policy Act for the Columbia River System. The three federal agencies will work with various state and federal agencies to develop and examine a reasonable range of alternative river operations. An Environmental Impact Statement is slated for completion in late 2021.

### 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[5] and Klamath Hydroelectric Settlement Agreement[6] in February 2010. These agreements set signatories on a path to comprehensive solutions for the Klamath Basin.

However, Congress did not enact authorizing legislation and the Klamath Basin Restoration Agreement expired in December 2015.

The Restoration Agreement was 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.

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

Examples of how to implement this action:

- Protect Oregon's interests in shared surface water and groundwater basins
- Negotiate agreements such that water protected instream is shepherded across state lines to the mouth of the river
- Partner with neighbors and tribes to continue or improve access to additional sources of water

The Klamath Hydroelectric Settlement Agreement has been amended twice and continues to be in place. The Agreement 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. The four hydroelectric dams on the Klamath River, one in Oregon and three in California are being transferred to a private corporation for decommissioning in 2020.

# Critical Issue – Water Management and Development

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 described further in this section: water-use efficiency and conservation, built storage, water reuse, non-traditional techniques, water resources development, the importance of a strong field presence, and strengthening our water permitting programs.

## Improve Water-Use Efficiency and Water Conservation

One of the more widely recognized approaches to managing demand for water—and stretching supplies of water—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, adding faucet aerators to bathroom and kitchen sinks, or installing low flow showerheads to use less water are fairly common activities today.

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 1.5 trillion gallons of water and $32.6 billion in water and energy bills. In Oregon, more than 35 organizations, including non-profits, drinking water providers, and various distributors promote WaterSense labeled products. [7]

Land management techniques, such as xeriscaping, 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.

### Water Conservation within Cities

Decreased water demands across several of Oregon's urban communities have emerged as a trend in recent years. Water providers in the Portland Metro area indicate that water demands at 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 reductions, but it is likely a combination of multiple factors, such as wetter summers, loss of manufacturing industry, and water conservation programs taking effect.

The Water Resources Department requires water utilities to examine conservation-based rate structures as part of their Water Management and Conservation Plans. As a result, some utilities have modified their water rates, further driving down demands for water. In a 2014 survey conducted by the League of Oregon Cities, 28 percent of responding cities reported the use of inclining block rates, which is the rate structure typically used to effect water conservation behavior.[8]

Many water providers in Oregon offer rebates for the purchase and installation of water efficient appliances; some also provide shower timers and leak detection kits free of charge to homeowners and businesses alike. 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.

### Water Conservation within Industry

Water conservation in business and industry not only saves money by using less water, it can also save on energy required to heat water and run equipment. In manufacturing operations, service and retail establishments, and other businesses, there are ample opportunities to use water efficiently. Just like in the home, water-efficient toilets, faucets, showerheads, clothes washers, and dishwashers can save significant amounts of water.

Water-intensive industries in particular have an opportunity to use more efficient processes, or even recycled water, for washing or flushing, in industrial processes, in chillers, and in cooling towers. Some businesses also take the opportunity to convert their greenspaces to xeriscapes, or to install weather-based irrigation systems to improve irrigation efficiencies.

Several water providers offer walk-through inspections to help commercial customers detect leaks or develop additional water-saving ideas.

### Water Conservation within Agriculture

Agriculture is the largest user of water in Oregon. Statewide efforts should focus on increasing voluntary conservation and efficiency efforts in the agriculture sector. This could result in significant water savings statewide. Although barriers to water conservation exist, there are several water conservation and efficiency technologies already in use that are particularly helpful to agriculture.

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 more efficient irrigation systems, including weather-based irrigation systems, soil moisture controls linked to weather data and computer controlled irrigation, drip irrigation, variable speed pumps that adjust to water-use needs, and piping or lining canals. Several irrigation districts, particularly in Central Oregon, have improved their water delivery systems through lining and piping projects to better manage water supplies.

Other agricultural technologies that facilitate 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.

The most recent Farm and Ranch Irrigation Survey, developed by the U.S. Department of Agriculture's (USDA) National Agricultural Statistics Service, shows Oregon irrigated an estimated 1.55 million acres of cropland in 2013.[9] The 2013 Survey reports Oregon producers applying, on average, 1.9 acre-feet of water per acre to grow their crops. By comparison, Washington applies 2.3 acre-feet, Idaho applies 1.8 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 forfeiting water rights.

The potential for reduced return flow or injury to other water users are also factors to consider when designing a water conservation project. Piping, lining, or other water efficiencies can greatly reduce the quantity and rate of return flows that traditionally make their way back to the stream. However, return flows can also be a major source of nutrient, sediment, and thermal loading to waterbodies. Some Water Quality Management Plans call for a reduction in return flows for that very reason.

A number of resources exist to help water users make water-use efficiency gains. The Bureau of Reclamation offers competitive grants for water and energy efficiency projects. Since 2004, Reclamation has awarded more than $18.5 million primarily to irrigation districts for piping or lining canals and ditches, and installing telemetry systems and related micro-hydro projects.[10]

Other funding sources are available from USDA's Natural Resources Conservation Service and Oregon Water Resources Department.

**Highlight Box**

**Modernizing Oregon's Irrigation Infrastructure**

Upgrading aging irrigation infrastructure is one of the greatest opportunities to meet Oregon's growing water needs. Additionally, irrigation modernization provides opportunities for hydropower generation, facilitates ecological restoration, and spurs economic development. Oregon's agricultural water users store, release, and divert water through a system of up to 125 year-old reservoirs, canals, and laterals. Many of these canals and laterals were dug by hand, lose water through seepage and evaporation, and create water management challenges for both out-of-stream and instream uses.

Through the Irrigation Modernization Program, Farmers Conservation Alliance (FCA) and the Energy Trust of Oregon partner with irrigation districts to:

- assess water conservation potential
- identify opportunities to conserve or produce energy
- examine the co-benefits to the environment, the economy, and communities
- develop a comprehensive system improvement plan
- identify and secure the resources to implement the plan

Districts like Swalley Irrigation District helped to create the model for the Irrigation Modernization Program. With a mix of federal, state, and private funding, Swalley Irrigation District and its partners have converted 10 of its 28 miles of open canals to pipelines and built a three-quarter megawatt hydropower facility, taking advantage of water on its way to farms. Swalley uses revenues generated from the carbon-free, fish-friendly renewable energy to pay off their modernization investments and fund future projects. The efficiencies created by the new pipelines mean that 4.1 billion gallons of water per year are now legally protected instream for fish, recreation, and the community at-large.

In 2016, the Clean Energy States Alliance, a national coalition of public agencies and organizations working together to advance clean energy, recognized FCA and the Energy Trust of Oregon's innovative work with the State Leadership in Clean Energy Award.

"The work done by the Farmers Conservation Alliance is a powerful example of how irrigation modernization can address multiple challenges and provide multiple benefits. The potential exists over the next decade for irrigation districts across the state to upgrade to more modern infrastructure, saving water, restoring streams and generating green, renewable energy. These investments in irrigation systems are also investments in the future resiliency, competitiveness and livability of Oregon's rural economies."

- Senator Jeff Merkley

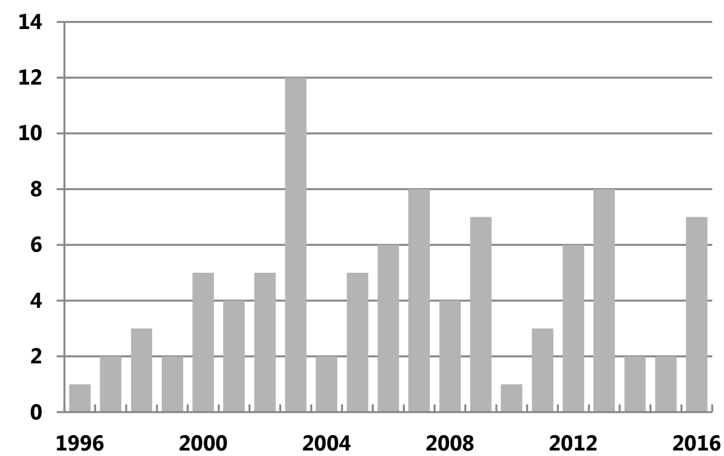
Find more information at: http://irrigationmodernization.fcasolutions.org/

## Existing State Tools for Water Conservation

**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 or leaky canals or ditches, or changing from a less efficient water distribution system, such as flood irrigation, to sprinkler or drip irrigation.

Since 1996, the Water Resources Department has received 96 applications for conserved water projects. More than 179 cubic feet per second (cfs) has been protected instream as a result of these water conservation/efficiency projects, and an additional 131 cfs of water has been made available for cultivation of additional farmlands.

**Figure 4-3: Allocation of Conserved Water Applications**
(1996-2016)




As a result of recommendations in the 2012 Strategy, this program has overhauled its forms and materials, making the program more accessible and understandable to users. However, recent surveys show that many irrigators and technical irrigation experts are still unaware of this program, or the benefits it can provide 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 —** 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 certain 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.

**Future Water-Use Efficiency and Conservation Programs —** Water users in Oregon have many tools available to encourage water conservation and more efficient use of water resources. However, the state does not have a coordinated program to promote such tools. Establishing a water-use efficiency and conservation program at the state level that provides technical assistance to water users in all sectors is needed. This was especially evident during the 2015 drought, as the state lacked resources to do effective outreach and education.

Developing such a program could include creating a user-friendly website, conservation materials for use by public and private partners, an on-line clearinghouse that highlights best management practices, funding, and technical resources. A clearinghouse could help water providers identify the potential for conservation and then design or improve their programs.

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

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 makes sense. Lastly, because water and energy are so closely tied, water conservation goals and efforts should be coordinated with energy efficiency programs. Below are two examples of state efforts to reduce energy and water use.

**Removal of Irrigated Landscape on I-84 —** The Wallowa Lake interchange on I-84 in La Grande is the site of a project by the Oregon Department of Transportation, District 13, replacing the grass with landscape rock. In 2015, at the height of Oregon's drought, irrigating the nearly five acres of grass took almost 5.4 million gallons of water, costing more than $13,000. Mowing the grass all summer cost thousands of dollars more. In future years, no water will be needed. The total cost of the rock was less than $100,000, which will be recouped in less than seven years—and save millions of gallons of water in the process.

**Net Zero Water System at Camp Rilea —** Camp Rilea, a military training facility in Warrenton, has created a net zero water system, resulting in its selection as an Army Net Zero Water Pilot Installation. Camp Rilea pumps groundwater onsite, treats the water to potable water standards at its water treatment plant, delivers the water throughout the installation for use, discharges to a wastewater treatment plant, and then pumps the treated effluent and captured stormwater to rapid infiltration basins to recharge the groundwater. Currently, Camp Rilea injects as much water through the rapid infiltration basins as what is pumped from groundwater for potable use, making Camp Rilea "net zero" for water use. Other specific projects implemented at Camp Rilea include: development of a Water Management and Conservation Plan, supply system and plumbing upgrades, wastewater treatment plant upgrades and modifications, expanded use of recycled water for irrigation, and conversion of irrigated turf to native meadow.

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

Examples of how to implement this action:

- Establish a water-use efficiency and conservation program that provides technical assistance to water users in all sectors
- Conduct a statewide water conservation potential assessment
- Prioritize agricultural water-use efficiency and conservation
- Develop an outreach strategy to expand participation in already-existing water-use efficiency and conservation programs

## Improve Access to 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 in reservoirs. Another 5,000 ponds were registered with the state in the mid-1990s. 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.[11] 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 regarding 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

Oregon can improve access to groundwater storage by encouraging the increased use of Aquifer Storage and Recovery (ASR) and Artificial Recharge (AR) for water storage. The use of these techniques is gaining interest, particularly in the northwest and north central regions of Oregon, due to the smaller environmental footprint, moderate cost, and potential associated benefits for water quality. Areas of the state designated as "groundwater limited" or "critical groundwater areas" may have greater capacity to develop ASR and AR projects.

Forming partnerships between different user groups, such as a municipality that treats water and an irrigation district needing an alternative source of water could help meet the financial and water quality obligations for ASR injection. The Water Resources Department may need to develop technical materials to help communities decide if such projects are worth pursuing. Grants for feasibility studies, discussed later in this chapter, have been used to explore potential aquifer storage projects. In 2016, the Department provided grants to Clean Water Services to study the feasibility of developing a stormwater ASR project in Beaverton. If deemed feasible, the stored stormwater would be recovered from an existing ASR well and used for irrigation during the summer months.

The Department of Environmental Quality, Department of Fish and Wildlife, and the Oregon Health Authority also play a role in ASR/AR projects. Water that is treated to standards safe enough for drinking water is the only source water allowed for ASR projects. Direct injection of water must be geochemically compatible with natural groundwater as well. This protects the groundwater resources, but can be an expensive standard to meet, particularly for non-municipal projects with large tracts of land.

The state has issued authorizations to 19 entities for testing the use of ASR and six for AR. 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. Figure 4-4 compares both technologies.

| Figure 4-4: Comparing Artificial Recharge and Aquifer Storage and Recovery Technologies | | |
|---|---|---|
| Category | Artificial Recharge (AR) | Aquifer Storage and Recovery (ASR) |
| 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 |
| Oregon Revised Statutes (ORS)<br>Oregon Administrative Rules (OAR) | ORS 537.135<br>OAR 690-350-0120 | ORS 537.531 to 537.534<br>OAR 690-350-0010 to 690-350-0030 |

## Above-Ground Storage — Reservoirs

Most storage water rights are for small ponds or reservoirs, those that store less than 9.2 acre-feet or with a dam less than 10 feet in height. The largest facilities are federal storage projects, including the U.S. Bureau of Reclamation's Owyhee Reservoir in southeastern Oregon with more than one million acre-feet of storage.

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 –** The Willamette Basin Project, a series of 13 dams and reservoirs, is owned and operated by the Army Corps of Engineers and can legally store 1.64 million acre-feet of water. 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.

The U.S. Bureau of Reclamation currently holds water right certificates to store water for irrigation use only. Reclamation is authorized to issue irrigation contracts; however, total contracts cannot exceed 95,000 acre-feet, according to the 2008 Willamette Biological Opinion. The water rights do not authorize stored water for municipal use or instream uses.

The Corps of Engineers, which owns and operates the Willamette Valley Project reservoirs, is conducting a feasibility study in the Willamette Basin. The Water Resources Department is sponsoring this three-year study, which will quantify the current use of storage and identify future water needs for irrigated agriculture, municipal, industrial, and instream uses in the Willamette River basin. The study's goal is to examine whether operational changes or modifications in the storage allocation from the Willamette Valley Project reservoirs would better serve present and future water needs in the basin. The study is scheduled to be completed in late 2018.

Similar conversations have occurred in the Crooked River basin to manage uncontracted stored water in Prineville Reservoir to meet increasing demands for fish and wildlife and other uses. Prineville Reservoir, southeast of Prineville on the Crooked River, was built by the Bureau of Reclamation in 1960 and was originally authorized for irrigation and flood control.

Congress passed the Crooked River Collaborative Water Security Act in December 2014.[12] This Act made revisions to the allocation of the water stored in Prineville Reservoir. The water right certificate allows Reclamation to store 155,000 acre-feet annually. The Act limits irrigation to 81,013 acre-feet, allows 5,100 acre-feet for the City of Prineville to use for mitigation of a new municipal groundwater permit, and the balance of uncontracted water to be released to support downstream fish and wildlife. This Act has created a storage system with more flexibility to meet a broader array of uses.

Currently, the U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, Water Resources Department, the Department of Fish and Wildlife, and the local irrigation districts are developing management plans and operational procedures to reflect the 2014 legislation.

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.

The United States Congress' recent reauthorization of the Bureau of Reclamation's Safety of Dams program will provide multiple public benefits for storage in the Tualatin Basin. This authorizes Reclamation to integrate dam safety improvements with additional benefits, such as conservation storage. Water providers in Washington County will use this opportunity to secure seismic upgrades for Henry Hagg Lake, while expanding the capacity of the lake to meet the region's water needs.

**Identifying Non-Traditional Storage Sites –** The Water Resources Department created an inventory of potential reservoir sites from past surveys conducted by different entities.[13] The purpose of developing the inventory was to create a clearinghouse of storage information. However, no attempt was made to assess the ecological or economic feasibility of these sites. The Department has provided this information so that communities can avoid "reinventing the wheel," in terms of site investigation.

Most of these potential dam sites in the inventory are located on major stream channels. Since the time of these surveys, Oregon has moved away from locating dams on significant stream and river channels, in large part because of effects on fish and aquatic life that must migrate through these streams. There has been very limited evaluation of above-ground storage sites that are located off-stream, on very small stream channels, or at sites with little or no effect on migration of fish and other aquatic life. Additional work is needed to locate potential reservoir sites in these more favorable locations.

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 that also provide benefit to fish and wildlife species and water quality.

**Evaluating Storage Infrastructure –** Oregon should evaluate the status of its existing storage capacity and infrastructure, including determining the maintenance and rehabilitation needs of dams. To improve access to stored water, Oregon should continue to support the Dam Safety Program, and identify ways to expand the capacity of existing above-ground storage projects—by raising a dam's height, removing sediment, or repairing the dam where safety restrictions have required lower water levels.

**Reserving Water for Future Economic Use –** A reservation sets aside unappropriated water for storage to meet future needs. Although it assigns a priority date, it is not the same as a water right application or permit. For example, approval of a reservation does not mean that any future application will be approved, or that a reservoir may be constructed. Water users wishing to appropriate reserved water must submit a water use application to the Water Resources Department, referencing the reservation. The Department then reviews the application based on current, applicable public-interest review standards.

During the 1990s, the Department of Agriculture requested reservations of water for future economic development, focusing primarily on the needs of agriculture. The reservations were originally approved for a period of 20 years, and were extended by the Water Resources Commission during 2015-16.

Reservations are in place in six basins: Grande Ronde, Hood River, Malheur, Malheur Lake, Owyhee, and Powder River, and are established by rule in basin programs. Each program's rules govern the appropriation and use of the surface and groundwater within the state's major river basins. These programs supplement statewide rules governing water use and allocation.

**Recommended Action 10.B**
**Improve Access to Built Storage**

Examples of how to implement this action:

- Encourage increased use of below-ground storage sites
- Re-allocate water in federal reservoir systems that have not undertaken formal allocation processes in Oregon
- Investigate potential off-channel sites for above-ground storage projects
- Evaluate the status of storage infrastructure, including the maintenance and rehabilitation needs of reservoirs
- Incorporate existing reservations of water into planning efforts

## Encourage 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. 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, Department of Fish and Wildlife, Water Resources Department, and Department of Consumer and Business Services (Building Codes Division), are all involved in different aspects of water reuse projects and proposals.

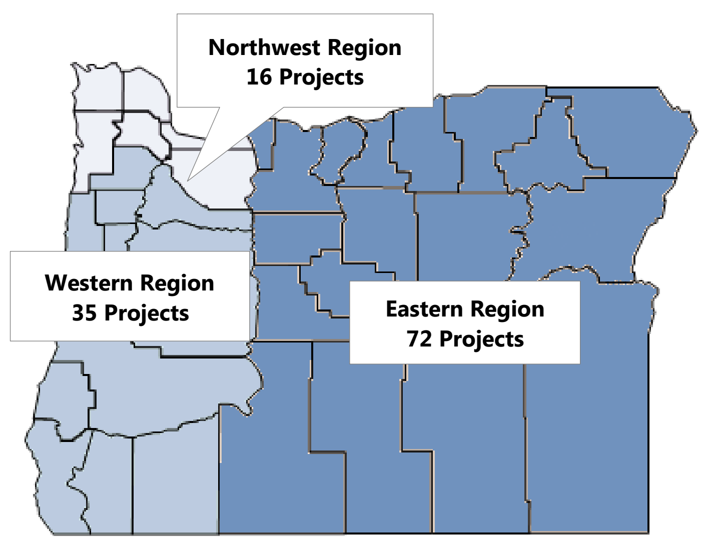
The Department of Environmental Quality (DEQ) is the lead agency in regulating the use of reclaimed water (called "recycled water" at DEQ). In consultation with the Department of Fish and Wildlife, DEQ determines whether the use would be beneficial to listed fish species and instream flow targets. The Water Resources Department determines whether the reclaimed water use would cause harm to other water rights; it also tracks the reclaimed water use in the Water Rights Information System database, noting the source of the water and where and how the water will be reused. Oregon Revised Statute 537.132(6) requires that the Water Resources Commission adopt and implement a set for rules for reclaimed water. Rulemaking for municipal water reuse/reclaimed water began in 2017.

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.

**Figure 4-5: Recycled Water Projects by DEQ Region**



- **The Use of Recycled Water –** Recycled water refers to treated effluent from a municipal wastewater treatment facility. Oregon has approximately 340 wastewater treatment facilities and there are more than 120 municipal facilities operating recycled water programs throughout the state, see Figure 4-5. Four classes of recycled water, based on various levels of treatment, can be reused for specific beneficial purposes. Communities have been taking advantage of State Revolving Fund loans for developing and upgrading recycled water systems, with seventeen such requests in 2009 alone.

- **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 have been traditionally limited to non-drinking water purposes, a wide-range of activities can occur, including irrigation of crops and pastureland and irrigation of urban landscapes. Cities commonly use recycled water to irrigate golf courses, athletic fields, and business parks. Recycled water can also be used for industrial cooling, dust control, street sweeping, and artificial recharge of groundwater.

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.

Reusing water can provide many benefits to both water quantity and quality. Water quality can be improved by the reduction of discharged treated effluent, such as a municipality treating wastewater and recycling it for irrigation. It can also provide a benefit to water quantity by reducing the demand on drinking water sources, for example, 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

Launched in Oregon in 2015, the Pure Water Brew annual competition has brought together beer homebrewers with the goal of building awareness around the benefits of recycled water. Highly purified water from Clean Water Services wastewater treatment plant is used to make beer for the competition. Clean Water Services was required to obtain approval for direct potable reuse by the Oregon Health Authority and the Environmental Quality Commission; both agencies approved the request in early 2015. In 2017, there were 40 brewers competing in the Sustainable Water Challenge/Pure Water Brew challenge. Direct potable water reuse for brewing is catching on in other states. Wastewater utilities in Arizona, Florida and Wisconsin are now hosting similar brewing competitions.[14]

In the summer of 2016, the West Extension Irrigation District began receiving recycled Class A Water from the City of Hermiston Recycled Water Treatment Plant. Discharge regulations designed to protect salmon in the Umatilla River during summer restricted warm discharge from the City, while at the same time, the irrigation district was seeking an additional source of irrigation water.

Working closely with the U.S. Bureau of Reclamation, Oregon Department of Environmental Quality, the Confederated Tribes of the Umatilla Indian Reservation, and other partners, the city and irrigation district designed an arrangement that addressed the needs of member irrigators, citizens, and regulators alike. Utilizing a $27 million Membrane Bioreactor Treatment System, the city is producing water that is virtually indistinguishable from drinking water quality. The resulting water is suitable for direct use on all food crops, including organically labeled produce. The Water Resources Department awarded the City of Hermiston and the West Extension Irrigation District the Tyler Hansell Agricultural Efficiency Award in 2017 for their reclaimed water project.

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, testing the water quality, and 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, and is, clearly communicating water reuse policies, procedures, and regulations, giving due consideration to the protection and augmentation of instream flow, as well as protection of water quality, public health, and drinking water sources. Oregon should also consider providing financial or technical incentives to increase and to track water reuse for municipal, industrial, and agricultural uses.

**Recommended Action 10.C**
**Encourage Additional Water Reuse Projects**

Examples of how to implement this action:

- Conduct a statewide assessment of the potential for additional water reuse
- Ensure that state agencies coordinate and communicate various policies, procedures, and regulations to facilitate reuse projects
- Provide incentives to increase and track water reuse

## Consider Non-Traditional Approaches to Meeting Water Needs

Storage and water conservation are a set of traditional tools for meeting water needs. 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, and think holistically about better ways to meet water quality, water quantity, and ecosystem needs.

### Desalination

Desalination is a technique that allows communities to stretch limited supplies in both inland and coastal communities by removing salt using reverse osmosis from brackish groundwater or surface water. This technique is used in more than 100 countries—most prominently throughout the Caribbean, Mediterranean, and Middle East. Communities in Florida and California are constructing or have constructed desalination plants.

Some of the greatest challenges to implementation include: intense energy requirements to treat the water; expansive coastline to site an energy source, pumps, pipes, inflows, and outfalls; damage to marine organisms during water intake, and brine disposal options. These challenges make desalination one of the most expensive sources of potable water.

Such projects would need to seek approval through existing regulatory pathways, and where appropriate, planning groups may need to identify barriers to desalination projects. Identification of these barriers would help the state examine policy changes or mitigation options where appropriate.

### Water Quality Trading

The Oregon Environmental Quality Commission approved rules in 2015 establishing a voluntary water quality trading program to facilitate pollution reduction and protect the quality of Oregon's waterways. The new rules provide clarity for regulated entities, the public, and Department of Environmental Quality staff.

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

Examples of how to implement this action:

- Assist in the research and development of non-regulatory tools to meet environmental outcomes
- Continue to develop water quality trading programs
- Develop protocols for translating streamflow restoration into credits and accounting strategies

Public and private partners throughout Oregon continue to work on developing 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 nutrient goals under the Clean Water Act and species habitat needs under the Endangered Species Act. This involves 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, the National Network on Water Quality Trading, and the National Fish and Wildlife Foundation are actively working on developing protocols. These protocols will help DEQ and dischargers make more informed choices about how to meet water quality requirements in more cost-effective ways, such as using riparian shade restoration to help achieve heat reduction requirements.

**Highlight Box**

**Restoration for Compliance in the Rogue River and Beyond**

In 2010, the regional wastewater utility for the City of Medford in southern Oregon had a problem. The treated wastewater it released into the Rogue River was too warm for salmon to thrive during migration, spawning, and rearing, putting it out of compliance with the Clean Water Act. Traditional solutions, like diverting water into holding ponds or building cooling towers, were likely to cost $15 million or more.

The City of Medford, Oregon Department of Environmental Quality, and non-profit partners Willamette Partnership and The Freshwater Trust designed a water quality trading program that allows the City of Medford to pay landowners to plant trees along the river to shade and cool the water. The Freshwater Trust, on behalf of the city worked with landowners, nurseries, and other contractors to restore forests that shade the Rogue River and its tributaries, reducing the effect of heat from the sun, filter stormwater runoff, create wildlife habitat, and sequester greenhouse gases. This approach is estimated to have saved the City and its ratepayers more than $8 million.

Clean Water Services pioneered water quality trading and riparian restoration for compliance in the Tualatin River through its 2010 and 2016 watershed-based National Pollutant Discharge Elimination System permits. The City of Medford's program built on that innovation by offering a different model wherein landowner recruitment, project implementation, and project verification were supported by third parties; utilities that are not able or interested in developing restoration projects themselves can still use water quality trading for compliance. As of November 2017, these projects have restored nearly 4.5 miles and 33 acres of native riparian forests, and reduced thermal loading by 420 million kilocalories per day.

The National Network on Water Quality Trading released a comprehensive guide identifying the key components of a trading program. In 2016, the Association of Clean Water Administrators and Willamette Partnership released a set of state water quality trading policy templates to provide a blueprint for other states, cities, or watersheds seeking to create a water quality trading program.

Find information at: http://willamettepartnership.org/our-stories/rogue-river/ - or -
https://www.thefreshwatertrust.org/case-study/medford-water-quality-trading-program/ -or-
http://www.oregon.gov/deq/wq/wqpermits/Pages/Trading.aspx

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 the concept of streamflow in these accounting strategies.

## Continue to Support a Water Resources Development Program

In recent years, the Water Resources Department has invested in a suite of funding and assistance tools to support communities that are dealing with various water issues—both consumptive and ecological in nature.

Water resources planning, noted earlier as "place-based integrated water resources planning" was highlighted in the first water strategy. Communities needed a way to conduct collaborative water planning at the local level, mirroring the goals and guiding principles of the statewide strategy. In the past, this type of watershed-based planning had only been done in a few places – like the Deschutes and Tualatin Basins – and there was a desire to support it elsewhere. The state drafted water planning guidelines and created a Place-Based Planning Grant program to support new planning efforts. Building a foundation around place-based planning will ultimately result in proposals, projects, or recommendations that are well-vetted by the local community and integrate a variety of instream and out-of-stream benefits and uses.

A separate fund supports feasibility studies, perhaps the most difficult project phase for project proponents to fund. Applicants exploring water conservation, water reuse, or storage can use grant dollars to analyze the technical merits, including the economic and environmental implications or benefits of a project concept. The first Integrated Water Resources Strategy recommended continuation of the Feasibility Study Grant program and it is still in place today.

Finally, the state recognizes a need to support implementation of water projects, and has created an account to fund projects that provide economic, environmental, and social or cultural benefits. While modest in comparison to other states, these investments can be leveraged with other federal or private sources to implement water projects that yield multiple benefits. This fund can also be used as match funding for federal programs like the Bureau of Reclamation's Basin Studies program that taps federal resources and expertise to conduct large-scale studies. Water Project Grants and Loans are discussed in greater detail later in the chapter.

The three elements—water planning, feasibility, and implementation—make up the state's Water Resources Development Program. The program was designed knowing that communities are at different stages of the planning/project spectrum. As they work to meet the water-related needs of humans and the environment, such communities will need partnership and technical resources all along this continuum.

**Recommended Action 10.E**
**Continue the Water Resources Development Program**

Examples of how to implement this action:

- Identify opportunities for the state to serve as a partner in water resources projects
- Seek out additional technical resources
- Find additional federal, state, private, and other match funds

## Provide an Adequate Presence in the Field

A number of Oregon's natural resources 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 that have written policies, but have limited capacity to implement or enforce them out in the field.

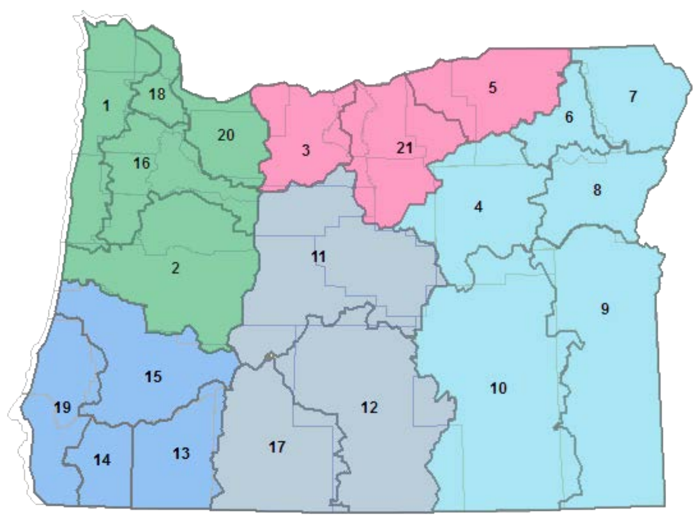
The Secretary of State's 2016 performance audit of the Water Resources Department underscored the importance of field staff by finding that, "Growing and changing demands coupled with a limited number of field staff impact WRD's capacity to effectively monitor and regulate Oregon's water supply. Field staff coverage overall has steadily declined and there have been some extended gaps in time where positions were vacant. Field staff have to cover a vast geographic region and associated workload. OWRD should regularly assess field staff workload to ensure it aligns to resources and that staff time is dedicated to critical responsibilities."

Field personnel collect data—including hydrological, biological, and chemical data—and protect public and environmental health through inspections and enforcement actions. Field personnel 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 with broad and deep knowledge of policy, technical, and legal expertise in their disciplines. They are the state's first responders to requests for help or information and are an integral part of the fulfilling agencies' statutory authorities

Field staff are important for protecting the rights of water users as well as protecting the public interest. While in the field, staff collect data, taking samples and measurements of groundwater and surface water. Field-related work also involves installing and calibrating water measurement and monitoring equipment.

Field personnel conduct site inspections, confirm compliance with permit conditions, guard against waste and contamination, inspect for hazards, and pursue enforcement actions when necessary. Finally, and perhaps most importantly, they are available to respond to requests for information and to provide public education year-round. The state's watermasters, biologists, water quality specialists, basin coordinators, and other field staff have a unique opportunity to strengthen ties and build relationships with local communities.

**Figure 4-6: OWRD Watermaster Districts**




**Water Resources Department –** The Water Resources Department has 167 staff, with approximately one-third located in field offices throughout the state. This is supplemented by about a dozen full-time and part-time county-funded assistant watermasters and hydro-technicians. Compare this to Portland Water Bureau, with about 580 staff, or the City of Bend, with 73 water, wastewater, and stormwater staff. The Owyhee Irrigation District in southeastern Oregon has 11 ditch riders, two full-time dam tenders, and two watermasters of their own to support water management of 118,000 irrigated acres.

At the Water Resources Department, field personnel implement Oregon water law and the Doctrine of Prior Appropriation. Under this Doctrine, it is the responsibility of field personnel—the state's watermasters and assistant watermasters—to regulate and distribute water, curtailing the water use of junior water right holders during times of water shortage.

The Department's limited field presence is noteworthy, given the large geographic territory and growing number of 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, the largest district in the state. Responding to a call for regulation at one end of the District can require an entire day's travel. In northwest Oregon, the District 16 watermaster oversees several hundred dams of various sizes and configurations that need routine inspection and site visits. In this district alone, there are 14,700 water rights that authorize the use of groundwater, surface water, and storage for a variety of uses. More than 12,000 of these water rights authorize more than 553,000 acres of primary and supplemental irrigation.

The Water Resources Department is undertaking a process to internally audit its workload and priorities in the field, re-distributing assignments as necessary to focus on mission-critical needs, given the available resources.

**Training –** Investing in field activities means more than just increasing the number of staff; it also refers to investing in their technical training, their level of skill, and distribution of workload. A significant amount of technical training is invested in each member of the field staff. The equipment and software used on the job are constantly becoming more sophisticated. Mastering these new tools and technologies will require additional education, training, and certification. Agencies also see the benefit of cross-training staff in the field, so that employees are familiar with multiple issue areas and can assist in the work of other staff or even in other Districts.

**Regulatory Tools –** As the demand for water grows and water supplies become further limited, the job of field staff becomes even more difficult. Field staff confirm that water right holders are using water according to their permits, and respond to complaints of interference or illegal water use. The field closely monitors streamflows and then manages the system accordingly to meet the call for water by senior water right holders.

The legal and statutory framework underpinning these activities needs to be up-to-date, clear, and responsive enough to keep up with modern day water use. This includes improving property access agreements, and making enforcement tools more nimble. In a similar vein, technology that is available to field staff (information, equipment, communications platforms, and transportation) must be efficient and accessible in order to be useful.

Communities have strong compliance with rules and laws in areas where field presence is robust and public education is strong and consistent. Areas of the state with a long tradition of regulation and partnership with the state have higher rates of compliance, resulting in more timely and efficient water management.

**Coordination and Communication –** Strengthening Oregon's field-based work will require financial investments in communications equipment, information platforms, and outreach materials. It also means a look at more efficient ways to coordinate and partner with other agencies to carry out our shared responsibilities.

The Department of Fish and Wildlife and Water Resources Department are examples of partners. ODFW field staff

**Recommended Action 10.F**
**Provide an Adequate Presence in the Field**

Examples of how to implement this action:

- Review and assess workloads; establish priorities and seek efficiencies
- Improve regulatory tools, including updating the legal and statutory foundation, modernizing technology and enforcement tools, and providing (cross) training
- Improve the ability for field staff to conduct education and outreach within their districts
- Enhance Department of Fish and Wildlife's capacity to work directly with water users and conservation interests

provide expertise on instream flow needs and can help prioritize streamflow restoration efforts, water use measurement projects, and voluntary initiatives or projects. ODFW staff can help determine potential impacts to fish, wildlife, and habitats from a proposed allocation of water and can recommend mitigation to offset the impacts.

## Strengthen Oregon's Water Quantity and Water Quality Permitting Programs

Several natural resources agencies in Oregon are engaged in water-related permitting. Just like the field staff described above, permit reviewers frequently answer calls or questions from water users, realtors, and others, conduct records research, and process case files. It is imperative that agencies have sufficient numbers of well-trained permitting staff in place to process requests in a timely, accurate manner.

### Water Right Permits

The Water Resources Department's Water Right Services Division administers several water right programs. Staff are responsible for processing water use permits, limited licenses, temporary drought permits, permit amendments, extensions, transfers (temporary and permanent), instream leases, conserved water projects, hydroelectric permits, reclaimed water use registrations, and more. The Department is also responsible for overseeing water management and conservation planning efforts of local entities and completing adjudication proceedings.

Once the Department determines that a new water use can be allowed, a permit is issued. The complexity of water-use applications has increased in the last twenty years; 80 percent of applications for new uses are for groundwater, which requires a thorough technical review. Water right permits, as well as newly-approved transfers, often include various conditions on the use of water. Installation of fish protection devices, totalizing flow meters, staff gages, water-use reporting, and taking annual groundwater measurements are common conditions for water use permits. Staff must make sure that water rights are conditioned correctly and staff must clearly describe to the water user what the conditions mean.

For staff to be effective, improving and expanding staff training is critical. The Division uses multiple programs for preparing and reviewing permits, certificates, and transfer documents. Investments need to be made to update technologies, manuals, and procedures that continue to improve efficiency, application processing time, and consistency between sections of the Department.

### Water Right Certificates

A water right certificate is the final stage of the water right permitting process. A report, called a "claim of beneficial use," must be submitted to the Water Resources Department. This detailed report allows the Department to evaluate the extent of water use developed within the timeframe allowed and within the terms and conditions of the permit.

For years, the Department struggled to keep up with reviewing these claims and issuing subsequent certificates. In 2004, there were 6,400 claims in the queue awaiting certificates. Since 2004, the Department has received approximately 4,760 new claims. With added staff and redistribution of workload, pending claims have been reduced dramatically. As of November 2017, there were 1,186 claims awaiting review. If the number of staff remains unchanged, the number of pending claims will be near 260 by the end of the 2020 calendar year.

The Department should develop informative outreach materials and follow-up procedures for permits, transfers, or extension applications, clearly explaining the requirements, especially any measurement or reporting conditions, to the water user. Meeting the terms and conditions of a water use permit or transfer is needed in order to obtain a water right certificate. Early, up front customer service at permit-issuance will help water users avoid compliance issues later on. Outreach materials should use layman's terms or define any technical terms, making them user friendly.

## Water Right Transfers

Having a water right certificate opens the door to other tools, such as transfers, that allow water users to change where their authorized water is diverted from, where it is used, or what it is used for. There is growing interest in the use of water right transfers to move water around to support 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 earlier in this chapter, is an innovative conservation tool available as part of the water right transfer program.

**Figure 4-7: Water Use Applications Received by WRD**

| Year | Permits | Transfers |
|---|---|---|
| 2012 | 173 | 179 |
| 2013 | 229 | 192 |
| 2014 | 319 | 249 |
| 2015 | 325 | 276 |
| 2016 | 416 | 341 |

The backlog in processing water right transfers in 2004 was about 760 applications. As a result of a number of process improvements conducted since 2014, the backlog as of July 2017 has dropped to 364 applications.

## Developing a Mitigation Strategy for Oregon

Mitigation will need to be more a part of the solution for Oregon. In the coming years, the state should develop a mitigation strategy, along with a roadmap to help water users and others understand what is needed and required. Mitigation is required for new groundwater use in portions of the Deschutes Basin. The development of a mitigation strategy would be beneficial anywhere in the state where acquiring a new surface water or groundwater use permit is otherwise not possible.

A statewide framework could set forth the legal authorities and possibly basic parameters, while basin-specific rules could provide more specific mitigation details depending on whether concerns are based on water availability, interference with other uses, or other potential impacts.

## Working with Partner Agencies

In Oregon, reviewing water right permits is done in partnership with other state agencies. The Oregon Departments of Fish and Wildlife and Environmental Quality review new water use permit applications to ensure that the proposed use is not detrimental to the protection or recovery of a threatened, endangered, or sensitive species and the use is consistent with existing water quality standards. In some cases, a new permit application can only be approved if it is conditioned in certain ways or mitigation is provided.

The Department of Fish and Wildlife's water program consists of just a few staff members, but frequently they are called upon to answer questions from their field staff, other agencies, and water users on proposed projects. The agency needs greater capacity to interact with the Water Resources Department, water right applicants, and field biologists. This would increase the understanding of water right review recommendations, including impacts to fish and wildlife, recommended mitigation obligations, and passage and screening requirements. Doing so would help facilitate a transparent, consistent, and stream-lined application process.

## Water Quality Permits

The 2015 Oregon Legislature directed the Oregon Department of Environmental Quality to hire an outside consultant to evaluate its National Pollutant Discharge Elimination System (NPDES) Water Quality permitting program and make recommendations to improve the quality and timeliness of individual NPDES permits. There are currently 360 individual municipal and industrial NPDES wastewater permits in Oregon, which must be renewed every five years. DEQ administers other water quality permits (general NPDES permits, Water Pollution Control Facility Permits, and water quality certifications), but the permit backlog that motivated this evaluation was concentrated in the individual NPDES permit program.

The consultants' work culminated in December 2016 with recommendations and an implementation plan.[15] The full report is available online. Through research and interviews with dozens of knowledgeable staff and stakeholders, the consultants identified a number of issues contributing to the NPDES permit backlog, including:

- Lack of clarity regarding decision-making responsibility
- Ambiguity regarding the roles of staff working on permits (technical advisor vs. regulator)
- Lack of coordination between water quality planning and permitting
- The difficulty for some dischargers to meet water quality standards, requiring complex regulatory solutions and/or expensive engineering

The consultants made numerous recommendations in the areas of leadership, community capacity, alignment across programs and with federal regulations, quality and efficiency, staffing and workload, program funding, and communications and progress reporting.

The overarching message in the consultant report is that eliminating the NPDES permit backlog and achieving a sustainable permitting program is dependent on addressing the recommendations in all topic areas, not all of which are fully under DEQ's control. The agency's fluctuating budget and multiple priorities, third party legal action, and the local capacity for planning, financing, implementing and operating treatment plant upgrades all represent significant barriers. If recommendations are only partially implemented, some gains may accrue, but a sustainable permitting program will not be possible.

DEQ and the Oregon Environmental Quality Commission are committed to implementing the recommendations in the report, and consider this to be a top priority for the agency – one that will likely require years of focused attention to resolve. Internal process improvements are underway and DEQ is engaging external partners and stakeholders to seek their assistance in implementing the report's recommendations.

The Water Quality program's immediate priorities include developing a longer-term work plan and a communications plan, implementing initial internal organizational changes, and undertaking a "permit readiness review." The readiness review identifies backlogged permits for which there are sufficient water quality data, compliance solutions, and community capacity to immediately proceed with permit renewal.

**Recommended Action 10.G**
**Strengthen Oregon's Water Quantity & Water Quality Permitting Programs**

Examples of how to implement this action:

- Expand staff training opportunities; provide adequate staffing
- Update technologies, processing manuals, and guidance documents
- Develop outreach materials and follow-up procedures to help water users understand the application process and permit, transfer, or extension requirements
- Develop a mitigation strategy
- Create stronger linkages among partner agencies
- Develop and implement a workplan to improve the quality and timeliness of individual National Pollutant Discharge Elimination System permits

The program will continue writing NPDES permits while implementing the recommendations, but during the initial stages, permit writers may be called upon to lend their expertise to critical process improvement efforts and updating permit writing tools and templates. DEQ plans to provide more information on next steps and expected outcomes during the 2017-19 biennium.

# Critical Issue – Healthy Ecosystems

Responsibility for managing, protecting, and restoring Oregon's ecosystems falls across a broad range of local, state, federal, and tribal agencies, as well as on private landowners and local organizations. Oregon has a rich history of work in this area, using numerous tools and institutions to help address and improve ecological conditions. Chapter 2 described the status of Oregon's ecosystems, but focused recommendations around measurement and monitoring efforts. By comparison, this section contains recommended actions related to ecosystem policies, programs, and projects.

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. 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 or access the floodplain;
- 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.

## Improve Watershed Health, Resiliency, and Capacity for Natural Storage

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. 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.

This section describes the important role that freshwater ecosystems play in Oregon and makes several recommendations for further improvements.

### Riparian Areas

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.

The state 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[16] and Oregon's Agriculture Water Quality Management Plans.[17] The state currently provides incentives for voluntary participation in these restoration-type projects, including funding and technical assistance. The Oregon Department of Fish and Wildlife, for example, administers a Riparian Incentive Program. One helpful research project for academics or agencies would be to identify and compare the list of state and federal incentives or funds available for riparian restoration.

## Wetlands and Floodplains

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 are also diverse habitats 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.

Oregon has lost about 40 percent of its original wetlands. The U.S. Fish and Wildlife Service estimates that Oregon has 1.4 million acres of wetlands today, compared to about 2.3 million acres of tidal and non-tidal wetlands that covered the same area in the late 1700s.[18] 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 disconnect in the valley's hydrologic regime has changed the character of the valley's wetlands and greatly altered their functions.

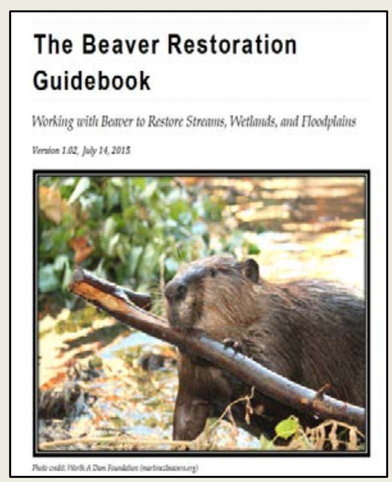
Developing a statewide floodplain policy could help establish a framework for regulation and permitting of floodplain restoration. Oregon should support ways to restore floodplain function, including implementation of actions described in Oregon's Conservation Strategy. This includes reconnecting rivers 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.[19]

Through their ability to hold and slowly release water, filter and biologically process nutrients, and provide shade and habitat, upland wet meadows, riparian wetlands, and floodplain habitats directly affect water storage, hydrology, water quality, water temperature and habitat quality. The U.S. Fish and Wildlife Service notes, for example, the Klamath Refuges shallow marshes, open water, and grassy uplands support one of the most biologically productive refuges within the Pacific Flyway. Approximately 80 percent of the flyway's migrating waterfowl pass through the Klamath Basin on both spring and fall migrations.[21]

**Figure 4-8: Beaver Dams**

Salmon recovery plans recently developed along the Oregon Coast have identified beaver habitat as important for improving ecosystem function. Beaver dams support the creation of Coho salmon rearing habitat by impounding water and retaining sediment, and generally facilitating the changes in river channels that can result in increased stream meanders, pool formation, and reconnected and expanded floodplains. Beaver dams also act to raise the water table in alluvial aquifers, thus helping to increase summer streamflows, reduce stream temperatures, and expand riparian areas and wetlands.

The U.S. Fish and Wildlife Service developed a Beaver Restoration Guidebook in July 2015 to help those working with beaver to restore streams, wetlands and floodplains.[18]




While beavers can threaten man-made infrastructure because of their burrowing and blocking tendencies, beavers and beaver dams can play an important role in maintaining the health of our natural systems.

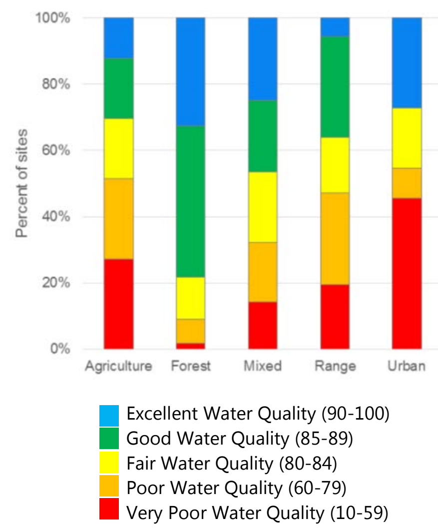
The Oregon Department of Fish and Wildlife has developed a clear set of guidelines to direct relocation efforts for beaver to carefully balance the potential for beaver to benefit fish and wildlife with possible damage issues.

## 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. Although most estuaries along the coast are relatively small, the Columbia River estuary at Astoria is the largest in area at more than 80,000 acres. 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. Managers along the West Coast are concerned about how sea-level rise and ocean acidification will alter estuaries and threatened species;[22] some communities are restoring tidal inundation to estuarine lands to build resiliency for coastal sea level change and tidal flooding.

**Figure 4-9: Influences of Land Use**
(from 2017 DEQ Oregon Water Quality Index)




## 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, store atmospheric carbon, and support Oregon's economy. Healthy forests promote soils that provide natural filtration to keep streams clean and water quality high.

Most of Oregon's municipal water systems rely on water that originates from forestlands, including those managed for wood production. At the state scale, data collected from DEQ's ambient monitoring network between 2007 and 2016 indicates that forestlands have the highest percentage of excellent or good water quality sites, compared to agriculture, urban areas, rangelands, and mixed land uses (see Figure 4-9).

Forests are part of the essence of Oregon, and our waters benefit from their sound management. However, 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 at risk of 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.

Forest diversity can offer a range of benefits when land managers incorporate multiple values—wood production,

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

Examples of how to implement this action:

- Improve riparian conditions to protect a healthy buffer between aquatic and terrestrial ecosystems
- Restore wetlands and floodplains to maintain critical functions like processing nutrients, providing habitat and storing water
- Protect estuarine conditions to maintain a healthy buffer between freshwater and marine systems
- Protect upland and forested areas, in part to maintain to source water quality
- Establish methods for measuring ecosystem services and incorporate results into planning efforts

aesthetics, recreation, habitat, water quality, and clean air. Awareness is growing that keeping forests in productive forest use should be a primary goal. Keeping forests as forests, however, requires public support, investment, and resource protection policies that make continued forest ownership an economically viable alternative to conversion. The Forestry Program for Oregon emphasizes this, and agencies should continue supporting efforts to maintain healthy, resilient, and functional forested areas, in part, for the benefit of water resources.[23]

## Develop Additional Instream Protections for Oregon's Rivers and Streams

In many areas of Oregon, streamflows are very low or even non-existent during late summer months. Low streamflow conditions may be further exacerbated by periods of intensive water use or drought. Low streamflows often mean higher water temperatures and increased nutrient concentrations, contributing to poorer water quality. Changes in the hydrologic regime, older culverts, and many 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.

### Scenic Waterways

The Oregon Parks and Recreation Department has the authority to recommend the designation of additional rivers or segments of rivers as scenic waterways. Oregon has one of the most extensive scenic waterway systems in the country, with more than 1,100 river miles protected for recreation, fish, and wildlife values. The designation of scenic waterways is a well-established tool that brings benefits to a local economy through recreation, while at the same time protecting natural values of the resource.

Oregon designated two new scenic waterways in January of 2016 – segments of the Chetco River in Curry County and the Molalla River in Clackamas County. These designations are now managed as part of the state's scenic waterway system and represent the newest additions to the program in more than twenty-five years.

These rivers were chosen because they meet the Scenic Waterways Act criteria for outstanding scenic, fish, wildlife, geological, botanical, historic, archeologic, and outdoor recreation opportunities. The Oregon Parks and Recreation Department utilized studies and citizen advisory groups to develop recommendations for designations and draft management plans for the two proposed waterways.[24] The Water Resources Department used the same advisory groups to develop scenic waterway flow requirements for the proposed reaches.

Additional designations are under consideration by the Oregon Parks and Recreation Department and its partners.

### Outstanding Resource Waters

Oregon's Environmental Quality Commission (EQC) has the ability to protect high quality waters that constitute an outstanding state resource, due to their extraordinary water quality or ecological values, or where special protection is needed to maintain critical habitat areas. In July 2017, the EQC designated the North Fork of the Smith River and its tributaries as "Outstanding Resource Waters," the first designation of its kind in Oregon or the Pacific Northwest.

Outstanding values of the North Fork Smith River include their exceptional clarity and color, valuable habitat for endangered populations of Coho salmon, several rare wetland plant species, and unique recreational opportunities, particularly for whitewater rafting and kayaking. The decision adds protections under Oregon's water quality standards to ensure that there is no degradation of water quality in these waters. The policies would prohibit new permitted point source discharges to the waters and would prohibit other activities that could degrade the current high water quality, exceptional ecological characteristics, and other outstanding values of the waters.

### Instream Water Rights

Oregon is working to establish additional instream water rights, where needed, to protect base flows, and continue to work on resolving protested instream water right applications. The Oregon Department of Fish and Wildlife's policy is to apply for instream water rights on waterways of the state to conserve, maintain and enhance aquatic and fish life, wildlife, and habitat, to protect and maintain water quality standards, and to support public uses relating to recreation and scenic attraction. The long-term goal of this policy is to obtain an instream water right on every waterway exhibiting fish and wildlife values.

Three agencies—the Department of Environmental Quality, Department of Fish and Wildlife, and Parks and Recreation Department—may submit applications for instream water rights to the Water Resources Department (WRD).

The Department of Fish and Wildlife is currently utilizing existing information to recommend flows for future instream water right applications and is prioritizing future studies. Collection and processing of new data is time-consuming, taking two to three years to complete each stream reach. New instream flow studies will provide data for future instream water right applications.

About 900 instream water rights were filed by state agencies during the early 1990s. Another 500 or so minimum perennial streamflows were established by administrative rule in the 1960s through the early 1980s and later converted to instream water rights. Many instream water rights afford protection during the summer months, with watermasters regulating stream reaches for the benefit of these rights. Other instream water rights are relatively junior to other water users on the stream and will depend on voluntary partnerships with senior water right holders to be effective.

Instream rights are held in trust by the Water Resources Department and are supposed to be measured and monitored. About 200 instream water rights have stream gages in place that monitor river flows. These gages show that instream water rights are generally met during fall and winter high flows, but met less consistently during summer low flows.

### Instream Transfers and Leases

Water users with existing water rights can also transfer water instream to restore streamflows, using several tools and programs administered by the Water Resources Department. Water users can voluntarily transfer their out-of-stream use, such as irrigation for agricultural crops, to restore instream flows on a temporary or permanent basis. The water user has the option of transferring an entire water right instream, or a portion thereof. 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.

Oregon is a leader in flow restoration. As of 2016, there were 416 active instream leases, instream transfers, and conserved water projects in place. Streamflow restoration transactions have resulted in 1,634 cubic feet per second of water protected instream for the benefit of fish, wildlife, recreation, and water quality.

**Recommended Action 11.B**
**Develop Additional Instream Protections**

Examples of how to implement this action:

- Designate Scenic Waterways where needed to protect recreation, fish, and wildlife uses
- Designate Outstanding Resource Waters where needed to protect extraordinary water quality or ecological values
- Establish additional instream water rights where needed to protect the full suite of flows for fish and wildlife, water quality, recreation, and scenic attraction
- Expand the use of voluntary programs to protect and restore streamflow, lake levels, and cold water refugia
- Expand the geographic range of flow restoration efforts by identifying flow restoration priorities

The majority of water put instream on a permanent basis through allocations of conserved water and instream transfers is senior water, with certificates pre-dating Oregon's 1909 water code.

Instream transfers and leases benefit greatly from active partnerships with Oregon's conservation organizations, including The Freshwater Trust, the Deschutes River Conservancy, and Trout Unlimited. Incentives offered by these organizations and others can help land 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. Developing and implementing strategies that identify and target watersheds with the highest instream flow needs helps to expand voluntary streamflow restoration beyond current efforts, on both public and private lands.

## Prevent 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 biologically 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.

Aquatic invasive species can flourish in waterways, choking out native plants that once grew there and clogging boat, hydropower, and irrigation infrastructure.

Quagga and zebra mussels, along with hydrilla (a waterweed), and Asian carp are among the top species of concern to keep out of Oregon. Quagga and zebra mussels and aquatic vegetation can be easily transported by trailered watercraft, and have spread rapidly in portions of the United States due to their adaptability, lack of natural predators and physical transport. Species like Eurasian watermilfoil and New Zealand mudsnails already contaminate some Oregon waterbodies.[25]

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 produce toxins or poisons that can cause serious illness or death in pets, livestock, wildlife, and humans. Some of Oregon's lakes and reservoirs experience annual outbreaks of blue-green algae.

Oregon's state agencies and partners should support the Aquatic Invasive Species Prevention Program and invasive species actions contained in the Department of Fish and Wildlife's 2016 Oregon Conservation Strategy. Key elements of the Strategy are to prevent new introductions of invasive species, control the scale and spread of infestations, and eradicate invasive species, if possible. This can be achieved by coordinating the efforts of public agencies and private citizens, including the use of boat inspection stations. Inspections act as a line of defense and

**Figure 4-10: Aquatic Invasive Species Prevention**

**ODFW performs a decontamination of quagga mussels at Ashland's watercraft inspection station.**

The Aquatic Invasive Species (AIS) Prevention Program was developed in 2009 with the passage of two bills by the Oregon Legislature. Through seven years of implementation, the AIS program has conducted more than 59,500 watercraft inspections which included 88 hot wash decontaminations for quagga/zebra mussels and more than 1,200 decontaminations for other types of aquatic invasive species.

The AIS Prevention Program is co-managed by the Oregon Department of Fish and Wildlife and Oregon State Marine Board. The primary objective is to keep Oregon's waters free of new aquatic invasive species.

an opportunity to educate the public about the risk of aquatic invasive species entering our state.

**Recommended Action 11.C**
**Prevent and Eradicate Invasive Species**

Examples of how to implement this action:

- Support the Aquatic Invasive Species Prevention Program
- Support the Oregon Conservation Strategy's seven statewide actions to prevent new introductions, and decrease the scale and spread of infestations
- Continue to implement and enforce ballast water management regulations

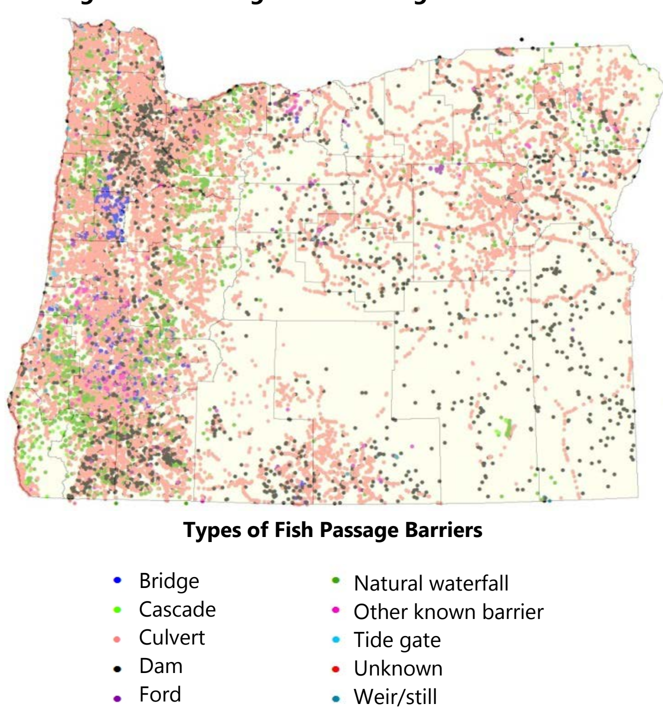
**Ballast Water –** The discharge of ballast water, used to provide stability for large commercial ships, is a primary pathway of concern for introducing non-indigenous species from foreign ports, potentially threatening our regional waterways.

DEQ was granted authority in 2002 to implement and enforce ballast water management regulations in an effort to reduce the risk of introducing new aquatic invasive species. State regulations prohibit the discharge of ballast water unless it meets specified management criteria that may include mid-ocean ballast water exchange or the use of shipboard treatment systems. Since 2012, the DEQ ballast water program has been supported by a 50-50 cost share between the General Fund and a fee on regulated vessels using Oregon waters. In addition to monitoring vessels for pre-arrival ballast management compliance, DEQ identifies high-risk arrivals and conducts vessel inspections and compliance verification sampling on at least 12 percent of vessels calling on Oregon ports.

## Enhance Watershed Restoration and 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, instream habitat enhancement, and restoration of streamflows. All of these efforts have helped improve the ecological and economic health of Oregon's communities. Our 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.

**Figure 4-11: Oregon Fish Passage Barrier Dataset**




**Fish Passage –** Barriers such as dams, dikes, road fill, and culverts change hydrological conditions and alter natural flow regimes. Many of these artificial obstructions create safety hazards for fish, can prevent fish passage altogether, alter transport of sediment and wood, and create an uneven distribution of habitat.

The 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. The Department of Fish and Wildlife has worked with several partners at the local, state and federal level to compile data on fish passage barriers throughout the state.

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

This ongoing effort has resulted in the identification of almost 40,000 potential 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 potential barriers that were compiled are culverts. Some of the potential barriers identified are passable; others are partially blocking or completely blocking passage. For barriers located on private lands, it is difficult to determine whether they 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, tribal, and federal agency inventories still need to be incorporated into the compilation.

**Highlight Box**

**Investing in Habitat for Native Migratory Fish in Oregon**

Creating incentives to remove barriers to fish passage could go a long way to improving conditions for native migratory fish in Oregon. Working with staff from the Oregon Department of Fish and Wildlife (ODFW) and the Oregon Department of Transportation (ODOT), Willamette Partnership and The Nature Conservancy have built a package of tools to support a pilot fish passage mitigation banking program in Oregon's North Coast that could do just that.

Mitigation banking shifts how impacts are addressed from a case-by-case basis to pooling investment in projects that yield the highest ecological benefit. The amount of habitat affected by a project or created at a bank site is defined in terms of credits or debits – these units of fish habitat, both quality and quantity, are measured by a habitat quantification tool called the Net Benefit Analysis Tool.

As part of the pilot, ODOT has created Oregon's first fish passage mitigation bank – by removing a high priority barrier on the East Fork of the South Fork Trask River, opening up 23 miles of stream habitat for native migratory fish.

**An effective mitigation banking approach to fish passage should:**

- Provide greater net benefits for native migratory fish than providing passage at a waiver site;
- Streamline the waiver process for fish passage banking and make approval transparent and defensible; and
- Target and invest limited resources in reopening access to high quality habitat for native migratory fish.

In exchange, ODOT can waive the provision of fish passage on culvert repair projects in limited amounts of lower quality habitat, creating a net benefit for salmon and other fish species. At the end of the pilot phase (2015-2018), ODFW will be evaluating its success and lessons learned to potentially develop a statewide mitigation banking program for Oregon.

"ODOT considers this a promising way to more efficiently address fish passage for culvert infrastructure repairs and replacements. This process will allow ODOT to make vital culvert repairs and replacements while providing an increased net benefit to native migratory fish over the existing waiver (mitigation) process."

Find more information at: http://www.dfw.state.or.us/fish/passage/mitigation.asp

**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 Department of Fish and Wildlife operates the state's fish screening program and has helped install more than 1,500 fish screens through its cost-share program. Since the early 1990s, the state has required fish screening and/or bypass devices as a condition of approval for surface water permits and transfers.

The 2017 Legislature extended the sunset for fish screen tax credits through the end of 2023. 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 fish-friendly culverts, constructing fishways, stabilizing road fill material, and retiring obsolete and push-up dams are all techniques employed in Oregon today that 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 calls for specific measures to improve water quality and quantity and to address factors that contribute to declines in fish populations and watershed health. Many of these measures are voluntary and depend upon the willingness of private citizens to implement restoration projects. These voluntary measures continue to be fundamental to the success of the Oregon Plan.

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 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 Water Resources Department and the Department of Fish and Wildlife completed a joint project that identifies priority areas for streamflow restoration in basins throughout the state. These mapped areas represent watersheds in which there is a combination of need and opportunity for flow restoration to support fish recovery efforts. These maps should be updated to reflect new knowledge, such as species distribution and climate change information.

More recently, the Oregon Watershed Enhancement Board has created the Focused Investment Partnerships concept that provides funding to address issues of significance, such as aquatic habitat for native fish, Coho habitat along the Oregon coast, closed lakes basin wetlands, coastal estuaries, and more.

Along with the Oregon Watershed Enhancement Board, several state agencies, federal agencies and non-profit organizations provide financial assistance for these restoration projects. The U.S. Department of Agriculture's Natural Resources Conservation Service, U.S Bureau of Land Management, National Fish and Wildlife Foundation, the U.S. Environmental Protection Agency, the U.S. Forest Service, the U.S. Fish and Wildlife Service, NOAA Fisheries, and the Oregon Departments of Fish and Wildlife and Environmental Quality 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.

### The Oregon Conservation Strategy

The Oregon Conservation Strategy, touched upon earlier in the invasive species discussion, was developed in 2006 and updated in 2016. 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, while recognizing that conservation issues vary by region and must be tailored to the unique needs of the fish, wildlife and human communities that coexist. The Oregon Conservation Strategy engages citizens in monitoring key species and attributes of ecosystems, and encourages measuring the effectiveness of conservation actions.

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

Examples of how to implement this action:

- Continue to update the inventory of fish passage barriers
- Remove fish passage barriers and support fish screening efforts
- Build upon existing ecological planning and restoration efforts
- Update streamflow restoration priority areas using new species distribution and climate change information

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.

## Develop Additional Groundwater Protections

Groundwater flow contributes to springs, wetlands, and streamflow throughout the state. Contributions from groundwater support ecosystems and human systems alike. Just as this Strategy calls for the development of additional instream protections, this 2017 update also calls for the development of additional groundwater protections. Such protections benefit groundwater dependent ecosystems as well as senior water rights.

The Groundwater Act of 1955 (ORS 537.505 to 537.795 and ORS 537.992) established the authority for groundwater management and monitoring statewide for the preservation of the public welfare, safety, and health. The Legislative Assembly recognized, declared, and found that the right to reasonable control of all water within the state from all sources of water supply belongs to the public. The Act directs the state to determine rights to the use of public groundwater and to manage groundwater in conjunction with surface water within the prior appropriation system, recognizing the hydraulic connection between the two water sources. Two examples: ORS 537.769 notes that groundwater protection is a matter of statewide concern; ORS 537.775 says that wells shall be constructed and operated so they do not unduly interfere with other wells or surface water.

The Groundwater Act also directs the state to determine the extent, capacity, quality, and other characteristics of its groundwater bodies, which are used to inform resource management decisions. Other important aspects of the state's groundwater management policy provide that rights to use groundwater be protected, reasonably stable groundwater levels be determined and maintained, and groundwater overdraft be prevented.

The protection of groundwater quality is also a value set forth in Oregon's water quality statutes in ORS 468B.155, "The Legislative Assembly declares that it is the goal of the people of the State of Oregon to prevent contamination of Oregon's groundwater resource while striving to conserve and restore this resource and to maintain the high quality of Oregon's groundwater resource for present and future uses." All groundwater in the state is a potential drinking water source and should be protected from untreated stormwater, pesticides, and other forms of contamination. This value is emphasized again in ORS 468B.160(6) and then again in ORS 468B.167, noting the importance of working with local partners on groundwater quality protection programs, such as wellhead protection. ORS 468B.175 and 180 lay out the rationale and process for declaring Areas of Groundwater Concern and Groundwater Management Areas. Finally, ORS 468B.190 calls for an ongoing groundwater monitoring and assessment program to evaluate the quality of the state's groundwater resources.

Potential sources of groundwater contamination have been mentioned throughout this document and include naturally occurring arsenic, nitrates, pesticides, chemicals and chemical spills, and coliform bacteria from improperly maintained septic systems.

In recent years, advances in technology have resulted in dramatically increased oil and gas production in many parts of country, and have raised public concerns around the practice of hydraulic fracturing (fracking) and the potential for groundwater contamination in drinking water. Hydraulic fracturing typically involves injecting water, sand, and chemicals under high pressure into a bedrock formation via a well.

For drilling operations that propose hydraulic fracturing, the Oregon Department of Geology and Mineral Industries, Oregon Department of Environmental Quality, and other natural resource agencies work together to ensure that regulatory requirements are met. Currently, Oregon has one producing gas field located in northwest Oregon. However, hydraulic fracturing has not been utilized at this production facility.[26]

Agencies will need to continue ensuring that adequate protections are in place to prevent groundwater contamination.

### Groundwater Policy Set Forth in Rule

In addition to the protections set forth in statute, the Water Resources Commission and Environmental Quality Commission have adopted numerous administrative rules to further guide agency responsibilities and functions related to groundwater management. Oregon Administrative Rule (OAR) 690-200-0005 notes that the Water Resources Commission has established a series of rules to protect groundwater. Some of these Chapter 690 rules include:

- Division 009 – Groundwater Interference with Surface Water
- Division 010 – Appropriation and Use of Groundwater / Critical Groundwater Areas
- Division 190 – Exempt Groundwater Use Recording Requirements
- Division 200 – Water Supply Well Construction Standards
- Division 205 – Water Supply Well Construction Standards / Licensing
- Division 210 – Well Construction Standards
- Division 215 – Maintenance, Repair and Deepening of Water Supply Wells
- Division 220 – Abandonment of Water Supply Wells
- Division 230 – Geothermal Production and Injection Well Standards
- Division 240 – Monitoring Wells, Geotechnical Holes, and Other Holes
- Division 310 – Water Right Application Processing; Groundwater Applications
- Division 410 – Statewide Water Resource Management

The Environmental Quality Commission has established rules under OAR 340-040-0020, confirming that its anti-degradation policy is intended to prevent groundwater pollution and to control waste discharges to groundwater. Some of the Chapter 340 rules include:

- Division 040 – Groundwater Quality Protection
- Division 044 – Construction and Use of Waste Disposal Wells...(Underground Injection Control)
- Division 045 – Regulations Pertaining to National Pollutant Discharge Elimination System and Water Pollution Control Facility Permits
- Division 050 – Land Application of Domestic Wastewater...Biosolids...Domestic Septage

- Division 051 – Confined Animal Feeding or Holding Operations
- Division 053 – Graywater Reuse and Disposal Systems
- Division 071 – Onsite Wastewater Treatment Systems
- Division 073 – Construction Standards
- Division 122 – Solid Waste Orphan Site Account
- Division 150 – Underground Storage Tank Rules

### Calls for a Groundwater Workplan

The health and future of Oregon's groundwater resources were featured in several important venues during 2016-17, including discussions of the Water Resources Commission, media articles, a Secretary of State audit, testimony before legislative committees, and discussions of the Integrated Water Resources Strategy Policy Advisory Group. The Water Resources Commission and Policy Advisory Group have both called for a long-term plan for sustainable groundwater management.

**Priority Issue Areas –** Looking at the 2012 Strategy and the Water Resources Department's *2016 Monitoring Strategy*, there are eight primary groundwater issues that require more work and attention in a workplan. They are as follows:

- Improve groundwater data collection, analysis, and sharing (Recommended Actions 1.B, 1.C, 2.B, 5.A)
- Conduct additional groundwater investigations (Recommended Action 1.A)
- Assess and adjust groundwater administrative areas (Recommended Action 1.A)
- Invest in updated scientific modeling tools (Recommended Action 1.C)
- Protect groundwater through proper well construction (Recommended Action 7.A, 12.A)
- Improve protection of groundwater during the permitting and regulatory process (Recommended Actions 10.F, 10.G)
- Develop a groundwater mitigation program (Recommended Action 10.G)
- Assist communities with groundwater storage projects (Recommended Actions 10.B, 13.D)

**Workplan Components –** An implementable workplan will need to be developed with the participation of agency staff, Commissioners, partners, and stakeholders. It should include the following elements: why the task is important, the anticipated implementation process, timelines, resource needs, and challenges/policy issues. Proposed milestones will of course be contingent upon budget and other workload needs.

The workplan should spell out what tasks can be undertaken given current resources, and which would require additional resources. It should also note where additional authorities or policy support is needed in statute and which tasks may require additional rule-making.

**Recommended Action 11.E**
**Develop Additional Groundwater Protections**

Examples of how to implement this action:

- Develop a long-term plan for sustainable groundwater management
- Develop clear objectives and metrics
- Identify and prioritize important tasks
- Sketch out the necessary timelines, staffing, and resource needs

# Critical Issue – Public Health and Water

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 resources 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 as 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 issues advisories when it is unsafe for recreational water activities at beaches and lakes, or when fish and shellfish consumed from various waters should be limited. These agencies work with several other state, federal, and municipal agencies to keep the public informed.

## Ensure Safe 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 days or weeks. Prolonged exposure of chemical contaminants, such as nitrate or arsenic, can cause cancer or organ damage. Drinking water is vulnerable to contamination from many potential threats. The federal 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 smallest public water systems. While the federal Safe Drinking Water Act regulates water systems serving at least 25 users or 15 connections, Oregon rules cover water systems serving at least 10 people or 4 connections. State resources to apply regulations to these systems are severely limited, leaving very small system users potentially exposed to contaminants in drinking water.

**Figure 4-12: Environmental Justice Tools and Resources**

The U.S. Environmental Protection Agency has developed an environmental justice (EJ) mapping and screening tool called EJSCREEN.[22] It is based on nationally consistent data and an approach that combines environmental and demographic indicators in maps and reports. This screening tool highlights places that may have higher environmental burdens and vulnerable populations. EJSCREEN can also be used to support educational programs, grant writing, and community awareness efforts.

Oregon's nationally recognized Environmental Justice Task Force was created by the Legislature to help protect Oregonians from disproportionate environmental impacts on minority and low-income populations. The Task Force released a handbook of best practices on environmental justice.[23] Completed in January 2016, the handbook lays out tools and approaches that promote meaningful involvement and participation of all stakeholders in the development of state agency programs, actions, and decisions.

### Source Water Assessments

From 1998 to 2006, the Oregon Health Authority and Department of Environmental Quality conducted source water assessments, and are working on updated assessments now. Public water systems will receive these new assessments with more detailed information on the watershed or recharge area that supplies their well, spring, or intake (the "drinking water source area"). Public water systems and local communities can use the information to voluntarily develop and implement source water protection strategies.

The drinking water source area for most communities lies partially, if not entirely, outside of their jurisdiction and may include several different governing agencies as well as a diverse mix of landowners, businesses, and residents. With that in mind, the updated assessments include details characterizing the source area and potential risks that will allow water systems to involve potentially affected stakeholders early when developing protection strategies.

**Find Data on Public Water Systems**

https://yourwater.oregon.gov/

Oregon Health Authority Drinking Water Services maintains an online searchable platform to display data on public water systems in Oregon. You can find data such as coliform and chemical test results, violations, enforcements, public notices, and basic system information, such as sources used, treatment applied, and contact information.

Updated assessments will also provide key information that will allow communities to focus limited resources on higher risks within their drinking water source area. The information can be supplemented with local water system and community knowledge that can serve as a collaborative effort to address local water quantity and water quality challenges. The delineation of sensitive areas and identification of potential contaminant sources can be further refined through additional research, local input, and coordination with state agencies.

### Source Water Protection [new sub-title]

Source water assessments can be used for planning purposes and development of source water protection strategies. Examples include:

- **Natural Resources Planning.** Groundwater systems that serve greater than 10,000 people or more 3,000 service connections can voluntarily have their drinking water source area certified by Oregon Health Authority. Once certified, the source area is considered a significant resource under the Department of Land Conservation and Development's Land Use Planning Goal 5. The Goal 5 planning process can be used by cities and counties to plan and zone land to conserve identified Goal 5 resources.
- **Contingency Plans.** Water systems can use the information regarding potential source water risks to enhance contingency plans. Contingency plans contain procedures to be followed should threats such as chemical spills or natural disasters occur. Guidance for preparing a contingency plan and examples are available from the Oregon Health Authority.
- **Water Development.** Information can be used to explore the development of additional drinking water sources, providing data that can help identify lower-risk well, spring, or intake locations and to identify surrounding areas that should be protected now so they provide quality drinking water in the future.

The Regional Water Providers Consortium, for example, has long been active in source water protection efforts, having prepared its first source water protection strategy back in 1998.[29] Consortium members rely primarily on the Bull Run Watershed, one of the most protected water supply watersheds in the nation, and the pollution control strategy relies heavily on prevention.[30] In the late 1990s, the Consortium, along with other drinking water providers, helped develop and support the state's pesticide use reporting system through several legislative sessions. The reporting system was administered by the Oregon Department of Agriculture but has not been funded since the 2007-09 biennium. The reporting system contains quite a bit of data but to become fully functional again, would need funding and a new database structure.

Detailed information about developing source water protection strategies can be found on the Drinking Water Protection Program website.[31] The website also includes methods and results, sample drinking water protection plans, information for schools, and links to many other useful sites.

### Contaminants of Emerging Concern

Some chemicals that previously had not been detected are now being found at very low levels because of improved testing methods. 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 the occurrence and concentration of contaminants, which can be used in studies to determine if or how such contaminants pose individual, cumulative, or synergistic health risks to the public. These data could be used in conjunction with the U.S. Environmental Protection Agency's Unregulated Contaminant Monitoring Rule data to evaluate connections among source sensitivity, potential contaminant sources in the area, and overall system vulnerability to contamination.

### 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 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 and 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.

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.

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

Examples of how to implement this action:

- Assist drinking water systems of all sizes; increase resources for small water systems (less than 15 connections)
- Protect drinking water sources
- Increase understanding of occurrence and health implications of contaminants of emerging concern
- Encourage water providers to join the Oregon Water/Wastewater Agency Response Network
- Increase domestic well testing and provide updated support materials and education

The Oregon Health Authority's Environmental Public Health Program launched a "Domestic Well Safety Program," developing a new website for well owners, providing information about water quality testing, treatment, maintenance, and other resources. In 2015, the Water Resources Department partnered with Oregon Health Authority to develop and distribute a Water Well Owners Handbook for rural homeowners.[32]

More domestic well testing is needed, along with resources to help educate and train homeowners on water quality testing of private wells, proper well installation and maintenance, and wellhead protection (see also Recommended Action 8.C, Promote Community Education and Training Opportunities).

## Reduce Toxics and Other Pollutants

Protecting Oregonians from the impacts of toxic pollutants is one of the top priorities for DEQ. Thousands of toxic chemicals are in products that individuals and businesses use daily. Old chemicals that may not be sold 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

DEQ is updating its toxics reduction strategy, a document that identifies reduction options for a range of priority toxic pollutants that affect air, land, and water quality. The updated strategy will focus on complementing and supporting the goals of existing core programs that address toxic chemicals and pollutants. To the extent practical, the updated strategy will place an emphasis on reducing toxic pollutants at the source, rather than managing them after they are generated.

Oregon DEQ's current Toxics Reduction Strategy, completed in 2012, emphasizes collaboration and partnerships with other agencies and organizations to reduce priority toxic chemicals in the environment and people.[33] In addition, Executive Order No. 12-05 ("Environmentally Friendly Purchasing and Product Design") provides additional support for DEQ's Toxics Reduction Strategy by focusing the work of other state agencies on reducing toxics.[34] Thus far, the Executive Order has resulted in low toxicity procurement guidelines for state agencies (and other public entities that join state price agreements), and became an official policy of the Department of Administrative Services.

In 2013, DEQ provided support to the Department of Administrative Services in developing and implementing low toxicity procurement specifications for a new janitorial supplies price agreement, in collaboration with the State of Washington. This price agreement represented an estimated $20 million in state and local government purchasing power. Similar safer chemistry product procurement efforts have been initiated for office supplies and furniture.

DEQ has also been collaborating closely with other states during the past five years, through the Interstate Chemicals Clearinghouse and other groups, to advance green chemistry and promote safer chemical alternatives to priority toxic chemicals that reduce environmental and health impacts while producing potential economic benefits.

Two other high priority short-term actions identified in the 2012 Toxics Reduction Strategy were to expand and enhance the Pesticide Stewardship Partnership program and ensure support for regular pesticide waste collection events to reduce non-point sources of toxic pollution in Oregon waters. These efforts are summarized in the following sections.

## Water Quality Pesticide Management Plan

An important task for managing pesticides is to implement the statewide Water Quality Pesticide Management Plan.[35] The Water Quality Pesticide Management Team, comprised of representatives from the Oregon Department of Agriculture, Department of Forestry, Department of Environmental Quality, Oregon Health Authority, Oregon Watershed Enhancement Board, 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 guidelines and reference points;
- Conduct 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, a voluntary, collaborative approach called the Pesticide Stewardship Partnership (PSP) program has been implemented to identify problems and improve water quality associated with current pesticide use at the local level. The state agencies comprising the Water Quality Pesticide Management Team work with Oregon State University Extension and the Integrated Plant Protection Center, soil and water conservation districts, watershed councils, grower groups, agricultural chemical distributors, and tribes to use monitoring data to drive focused voluntary actions in watersheds that reduce pesticide impacts on water quality. Prior to 2013, the PSPs were funded largely through federal grants and in-kind contributions from partners. The Oregon Legislature provided stable funding to the Department of Agriculture and Department of Environmental Quality for PSP implementation and expansion in 2013 and 2015. These funds support water monitoring, data analysis, project coordination, pesticide waste collection, and stewardship technical assistance grant projects. The Water Quality Pesticide Management Team helps guide these local partnerships and assists in the interpretation of the monitoring data.

Currently there are nine partnerships in eight watershed areas. Work is underway in Hood River; Mill Creek and Fifteenmile Creek (in Wasco County); the Walla Walla River; Clackamas River; Pudding River; Yamhill River (Yamhill PSP for rural and urban areas, and South Yamhill River PSP for forested areas of the watershed); the Amazon Creek watershed project in Eugene, and the Middle Rogue watershed near Medford. Pilot water monitoring has also occurred in the Middle Deschutes (near Madras), South Umpqua (near Roseburg), and South Coast (near Coos Bay and Bandon) watersheds.

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

**Highlight Box**

### Pesticide Stewardship Partnership in the Clackamas River Basin

Partners in the Clackamas River Basin are targeting efforts to improve and protect water quality.  Initiated in 2005, the Clackamas Basin Pesticide Stewardship Partnership (Clackamas PSP) is a voluntary, collaborative process to protect the river and its tributaries.

Local and state organizations offer water quality monitoring, resources and training for landowners and managers to enable more efficient and effective pesticide use that reduces drift and runoff.  Pesticides in the Clackamas River watershed have many applications including residential lawns and gardens, business landscaping, public parks, road and ditch maintenance, nurseries, berries and vegetables, Christmas tree farms, forestry, and golf courses.

Partners created a windsock program where calibrated windsocks are provided to growers throughout Clackamas County.  The windsocks attach to sprayers so that when an applicator reaches the end of a row they can see in real-time the approximate wind speed and direction.  This allows growers to make better decisions when spraying and avoid pesticide drift.

The program is a partnership between the Clackamas Soil and Water Conservation District (SWCD) and the Clackamas River Water Providers, a coalition of municipal water providers that obtain drinking water from the Clackamas River.

> Sprayer calibration and smart sprayer technology dramatically reduces off-target pesticide loss.  Several partners, including Clackamas SWCD, OSU Extension, ODA's Integrated Plant Protection Center, and Clackamas River Water Providers have offered several calibration training events to local growers and producers.

The Clackamas PSP also utilizes state and/or local funds to hold agricultural pesticide collection events.  Since 2009, the Partnership has collected and paid for proper destruction of 66 tons of old, restricted, or damaged pesticides.  The Clackamas SWCD has partnered with the Clackamas River Water Providers on all events.  Other event partners have included the Oregon Department of Environmental Quality, Oregon Department of Agriculture (ODA), Clackamas River Basin Council, and Clackamas County.

The Clackamas River Basin Council has done water quality monitoring to support the Clackamas Pesticide Stewardship Partnership.  Several other partners do macroinvertebrate monitoring to evaluate water quality.

In the future, partners plan to continue promoting the use of beneficial insects to control agricultural pests and reduce pesticide use, along with encouraging erosion control practices such as field borders and cover crops to keep soil particles containing legacy pesticides out of surface water sources.

For more information:  https://conservationdistrict.org/programs/pesticide-stewardship-partnership

## Hazardous Waste Collection – Pesticides and 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.

Pesticide waste collection events around Oregon provide an opportunity to bring unused and unusable pesticides from agricultural growers and other commercial and institutional pesticide users to a central location to properly dispose of them for free. These collection events help to remove old or unusable pesticides that pose a direct threat to Oregon's water quality. Since 2014, when regular collections began with stable funding from the Oregon Legislature, more than 209,000 pounds of pesticides have been collected at collection events from more than 350 commercial or institutional pesticide users. These events have now been incorporated into the state PSP program. Some state pesticide collection funds are also transferred to county and regional entities (representing Hood, Sherman, Wasco, Union, Baker and Wallowa Counties) that operate permanent hazardous waste collection facilities to support their periodic free agriculture pesticide collections for local growers and other pesticide users.

Like pesticides, unused medications can pose problems for Oregon's water resources. Often, unused or expired medications are disposed of by flushing down drains in homes, care facilities, medical clinics, doctors' offices, and hospitals. In a 1999 national study, scientists analyzed streams for 95 different organic wastewater contaminants, including pharmaceutical compounds.[36] One or more of these wastewater contaminants appeared in 80 percent of the streams. These results were mirrored in a 2014 report by U.S. Environmental Protection Agency Region 10, which summarized studies of water quality, sediment samples, and fish tissue, finding evidence of estrogen-like compounds, pharmaceuticals, personal care products, perfluorocarbons, and flame retardants throughout the Columbia River and its tributaries.[37] Risks posed to aquatic organisms by long-term exposure to various pharmaceutical compounds are unknown.

Wastewater treatment plants and septic systems, depending on the level of treatment, may only partially treat pharmaceuticals which would allow 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; and protects water quality and aquatic species.

Oregon should continue "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 have historic releases of hazardous substances that threaten water resources. The nature and degree of such threats depend on the types and amounts of contaminants, when they were released, the likelihood of migration to surface water or groundwater, and remedial actions completed, if any. Oregon's Leaking Underground Storage Tank program identifies and addresses hazardous or contaminated sites, and prioritizes investigative and remedial actions based on threats to human health and the environment – with a focus on protecting sensitive water resources. Site owners complete most work on a voluntary basis, with program oversight. However, as needed, the program uses enforcement mechanisms to eliminate or treat discharges to sensitive water resources. This includes use of DEQ's Orphan Site Account when site owners are unknown – or unable (and in some cases unwilling) – to perform immediate cleanups. For lower priority sites, it is important to continue providing technical and financial assistance to clean up existing contaminated sites that could in the future affect groundwater or surface water.

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.

In Oregon, brownfields have been cleaned up and turned into new businesses with new jobs; urban community gardens; mixed-use developments that include housing, retail, and commercial facilities; food bank operation centers; thrift stores; and health-care centers in a number of rural Oregon communities. The economic and community development opportunities are many for brownfields, and DEQ takes this effort seriously, in order to prevent future exposure to contamination and ensure that environmental justice and community health concerns are integrated throughout redevelopment and reuse planning. Therefore, Oregon will 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 fish and shellfish accumulate toxic chemicals because of legacy contamination, spills, or toxic algal blooms, they can pose health risks to those who consume them. DEQ 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 worked with tribes, agency partners, and other stakeholders to revise the fish consumption rate and Oregon's water quality standards. These standards, approved by U.S. Environmental Protection Agency in 2011, 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 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 beaches, rivers, lakes, and other water bodies.

Issuing fish and shellfish consumption advisories is one such tool used by agencies. The Oregon Health Authority issues fish consumption advisories, due primarily to moderate-to-high mercury levels or PCBs (polychlorinated biphenyls) found in locally caught fish. As of April 2017, there were 19 specific water bodies where fish consumption advisories existed. In 2016, a statewide advisory was issued for mercury in bass.

In 2015, the Oregon Health Authority worked with DEQ and the Department of Agriculture to issue a coastwide advisory limiting the consumption of softshell clams (*Mya arenaria*) and gaper clams (*Tresus capax*), due to elevated levels of inorganic arsenic.

The Departments of Agriculture and 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 algal 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 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.

**Harmful Algal Bloom Advisories –** Public health and safety concerns associated with recreational use of lakes and other waters have been growing over the past several years. Blue-green algae, or cyanobacteria, can irritate skin, cause liver damage, or affect the nervous system and thrives in warm, stagnant waters that have significant concentrations of nutrients, particularly phosphorus. An overgrowth of algae in the water can result in the development of a harmful algal bloom (HABs), which can produce extremely dangerous toxins that can sicken or kill people and animals.

The U.S. Environmental Protection Agency notes that HABs are a major environmental problem in all 50 states. In Oregon, algal bloom advisories are only issued for lakes, reservoirs, and rivers where a lab has verified the presence and quantity of a harmful algae species or the toxins they produce. Only a fraction of Oregon's many water bodies are monitored for HABs due to limited staff and monetary resources.

The Oregon Health Authority is the agency responsible for posting warnings and educating the public about algal blooms. Once a waterbody is identified as having HABs, DEQ is responsible for investigating the causes, identifying sources of pollution and writing a pollution reduction plan. DEQ developed a Harmful Algal Bloom Strategy in 2011 to describe and recommend improvements to an overall strategy that the Department can implement in order to prevent and control, where possible, HABs in Oregon.[38]

Recommendations include seeking resources to improve the capacity to coordinate agency responses to address public health concerns and enhancing DEQ's focus on identifying and addressing the specific causes of waterbodies impaired by HABs.

Along with better coordination and monitoring, key preventative actions include reducing the formation of blue-green algae in lakes, streams and ponds beyond natural background levels. 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 federal 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 provides funding to monitor the coast and recreational shellfish for cyanobacteria, given the federal budget environment, these and similar programs are at risk of being eliminated.

**Recommended Action 12.B**
**Reduce the Use of and Exposure to Toxics and Other Pollutants**

Examples of how to implement this action:

- Update and implement the Department of Environmental Quality's 2012 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
- Continue "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 2016, Oregon adopted the U.S. Environmental Protection Agency's 2012 Recreational Water Quality Criteria, revising bacteria standards in freshwater and estuaries, and lowering the Beach Action Value that is used to trigger public notification programs.[39] If the Oregon Beach Monitoring Program were able to sustain current monitoring efforts, the revised standards would likely result in double the number of beach advisories. However, it is more likely that Oregon will experience both a decline in the frequency of monitoring activities/number of monitored locations and some increase in the number of beach advisories.

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.

## Implement Water Quality Pollution Control Plans

The long history of assessing and reporting on the conditions of Oregon's waters began in 1938 when the Oregon State Sanitary Authority (now the Oregon Department of Environmental Quality) was established as a result of a citizen initiative.

Today, the 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.

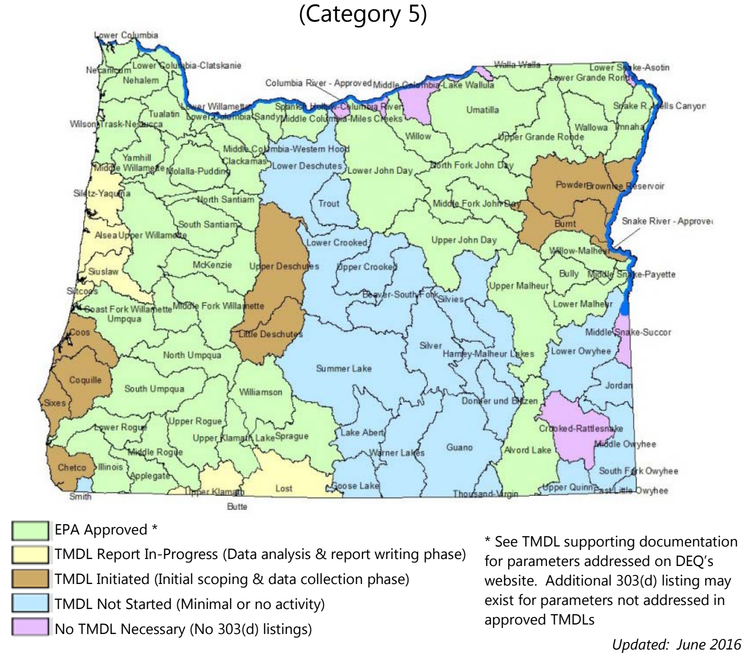
It is important to continue developing and implementing TMDL plans for water bodies that do not meet water quality standards. This includes developing TMDLs for remaining water bodies and pollutants on Oregon's 303(d) impaired waters list and for those added in the future, in accordance with the federal Clean Water Act. It also includes reviewing and updating existing TMDLs and providing oversight to ensure that TMDL implementation measures are effective. By the end of 2016, the Department of Environmental Quality had completed 1,153 TMDLs (see Figure 4-13).

### Nonpoint Sources of Pollution

A nonpoint source (NPS) of pollution is any pollution entering a waterbody that does not come directly from a pipe. Unlike end-of-pipe pollution that originates from industrial and sewage treatment plants, NPS comes from many diffuse sources, including runoff from agricultural, forest and ranching activities, construction sites, home landscaping, and road surfaces.

Oregon's Nonpoint Source Pollution Program is an important part of the state's water pollution control programs because for some pollutants, nonpoint sources are a major contributor of pollution to a waterbody. The Program's strategy involves using water quality management programs in conjunction with regulatory, voluntary, financial and technical assistance. The program's primary components are assessment, planning, implementation, and education.

**Figure 4-13: TMDL Development Status for 303(d) Listed Waters**
(Category 5)



The federal Clean Water Act provides states, territories, and tribal governments opportunities for funding, commonly referred to as Section 319 grants, for technical assistance, education, training, technology transfer, demonstration projects and monitoring to assess the success of specific nonpoint source implementation projects. In 2010, Oregon awarded more than $1.38 million in Section 319 grants to 33 projects to address nonpoint source pollution. In recent years, the amount of 319 funds Oregon receives from the U.S. Environmental Protection Agency has been reduced to less than a third of 2010 levels. Oregon should work with its Congressional Delegation to restore the level of funding to 2010 levels and implement nonpoint source pollution reduction projects.

There are also several Farm Bill conservation programs, administered through the Natural Resources Conservation Service, for agricultural producers and landowners. In recent years, Oregon ranchers have worked extensively with public and private sector partners to install and model effective habitat restoration techniques. These include fencing riparian areas and building stock water troughs to protect sensitive riparian areas from livestock.

Oregon will need to continue assisting landowners with the management of nonpoint source pollution across all land uses (e.g., urban, agriculture, forestry) to ensure the protection of surface water and groundwater. This should build upon the Forest Practices Act and the Agricultural Water Quality Management Act and area plans to ensure compliance with water quality standards and TMDL load allocations. Monitoring would help improve 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 permits are required for stormwater discharge that leaves the site through a "point source" and reaches surface waters either directly or through storm drainage.

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 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 the U.S. Environmental Protection Agency 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 MS4 permits, TMDL Implementation Plans for Urban Designated Management Agencies, best management practices, or through comparable voluntary plans.

### Septic Systems in Rural Areas

State law provides DEQ 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 the counties of Baker, Coos, Curry, Grant, Jackson, Josephine, Morrow, Union, Wallowa, and Wheeler. The 26 remaining counties manage the program through local governments under contract and oversight from the state.

In 2016, the Oregon Legislature provided seed funding for DEQ to award a grant to a third-party lender to establish a low-interest loan program for the repair or replacement of failing on-site septic systems. The primary objective was to create a financial assistance program for low and moderate income applicants facing expensive repairs or replacement, who are unable to obtain traditional financing.

In September 2016, DEQ awarded a $200,000 grant to the non-profit lender Craft3 to develop and implement the program. If successful, DEQ is hopeful that additional funding from public and private sources can be made available to make low-interest loans available to more Oregonians who need them.

**Recommended Action 12.C**
**Implement Water Quality Pollution Control Plans**

Examples of 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 and evaluate the effectiveness of pollution control plans
- Ensure effective management and oversight of stormwater in urbanized areas
- Assist communities with septic system challenges

# Critical Issue – Funding for Oregon's Water

This section lays out funding needs in five fundamental categories discussed throughout this document: funding Oregon's Integrated Water Resources Strategy, water resources management at state agencies, and assisting with local water challenges by funding planning, feasibility studies, and implementation efforts.

## Fund Oregon's Integrated Water Resources Strategy

During 2015-17, the Water Resources Department had one full-time coordinator developing the 2017 Integrated Water Resources Strategy. The Departments of Agriculture and Fish and Wildlife each had one staff member as well; the Department of Environmental Quality had three.

The state is required to update the Strategy every five years. This allows us 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.

Meaningful strategy involves public interaction, regular meetings of the Policy Advisory Group, Agency Advisory Group, and Federal Liaison Group, briefings of boards and commissions, and countless hours tracking down the status of Oregon's water-related policies, programs, and practices.

The goals, objectives, and recommended actions spelled out in the Integrated Water Resources Strategy require dedicated funding for implementation and coordination among state, local, federal, and private partners.

**Recommended Action 13.A**
**Fund Development and Implementation of Oregon's Integrated Water Resources Strategy**

Examples of how to implement this action:

- Fund implementation of the 2017 Integrated Water Resources Strategy
- Fund the five-year required updates, next one scheduled for 2022

## Fund Water Resources Management at State Agencies

Although some of the recommended actions in this document fall under the purview of the private sector, nonprofit organizations, or academic institutions, the majority of recommended actions will fall to the public sector, particularly state agencies. The state plays a complex role when it comes to water resources management—supporting economic development while also protecting the public interest in areas like the environment, public health, and public safety.

The Integrated Water Resources Strategy sets forth recommended actions and provides examples of potential ways to implement these actions. For day-to-day operations at state agencies, there are myriad examples of implementation activities that require funding:

- Improving scientific information for surface water and groundwater, including data collection, analysis, sharing, and use in decision-making
- Overseeing measurement and reporting by water users
- Conducting economic studies and water demand forecasts—both instream and out-of-stream
- Updating technical tools, including software, apps, databases, maps, models, and education/outreach materials
- Updating plans for strategic measurement, place-based planning, hazard mitigation/resiliency, and river basins
- Understanding and protecting streamflows, lake levels, groundwater, wetlands, floodplains, and refugia
- Updating water quality standards and TMDLs
- Improving water research and expertise related to energy use, building codes, land use, climate change, extreme events, water-use efficiency and conservation, re-use, storage, and other water management issues
- Providing forecasting and evaluation tools with regard to climate change, drought, flood and earthquakes
- Strengthening our field presence to communicate with and to educate the public about water issues
- Conducting compliance, public health/safety monitoring and inspections; requiring necessary improvements
- Protecting and restoring instream habitat and access, including fish passage and fish screening
- Studying and designating additional scenic waterways, outstanding resource waters, and instream water rights
- Monitoring for and preventing invasive species, toxics, pollution, and hazards
- Coordinating and partnering with other public and private entities
- Evaluating program effectiveness
- Providing engineering, scientific, permitting, regulatory and other technical expertise to partners, stakeholders, and customers

### Sources of Agency Funds

The operating budgets of Oregon's natural resources agencies depend on a variety of funding sources, which can dictate the activities on which state agencies have time, staff, and resources to focus. Economic development activities, for instance, are often partially supported by fee revenues or contract funds. Environmental protection activities have often depended on federal funds, but federal funds have dwindled in recent years.

**The General Fund —** The General Fund is used for a variety of public purposes and the amount of General Fund is limited, meaning there is intense competition for these monies. The General Fund is also used to pay for education, human services, and public safety. In 2009-11, the General Fund investment in natural resources agencies equated to less than one percent, or $145 million, of the $13 billion General Fund budget. In the most recent budget (2017-19), that share has inched above one percent with $221 million of the $19.9 billion budget.

**Figure 4-14: General Fund Support for Natural Resources Agencies**

| | Legislatively Adopted Budget | | | |
|---|---|---|---|---|
| | 2011-13 | 2013-15 | 2015-17 | 2017-19 |
| Agriculture | 12.9 | 18.7 | 23.4 | 22.3 |
| Columbia River Gorge Commission | 0.8 | 0.9 | 0.9 | 1.0 |
| Health Authority - Drinking Water | 0.0 | 0.0 | 0.0 | 0.0 |
| Energy | 0.0 | 0.0 | 0.0 | 0.0 |
| Environmental Quality | 25.1 | 29.9 | 33.9 | 44.6 |
| Fish and Wildlife | 7.1 | 17.2 | 30.1 | 28.4 |
| Forestry | 47.9 | 54.4 | 63.4 | 68.2 |
| Geology & Mineral Industries | 2.5 | 2.5 | 4.1 | 4.6 |
| Land Conservation & Development | 10.9 | 12.3 | 13.2 | 13.0 |
| Land Use Board of Appeals | 1.3 | 1.5 | 1.8 | 1.9 |
| State Lands | 0.0 | 0.0 | 0.3 | 5.0 |
| State Marine Board | 0.0 | 0.0 | 0.0 | 0.0 |
| Parks & Recreation | 0.0 | 1.0 | 0.0 | 0.2 |
| Water Resources | 20.6 | 26.5 | 29.6 | 31.5 |
| Watershed Enhancement Board | 0.0 | 0.0 | 0.0 | 0.2 |
| **Total GF for Natural Resources:** | $129M | $165M | $201M | $221M |
| **Total GF Budget:** | $16.5B | $15.6B | $17.9B | $19.9B |
| **Percentage of Total:** | **0.95 %** | **1.06 %** | **1.12 %** | **1.11%** |

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 they decline with each economic recession.

Federal funding in general is expected to dwindle. This loss will be further amplified if state agencies no longer have the state funds to enter into cost-match arrangements with federal agencies; federal matching funds will be left on the table as well.

The state's core responsibilities related to water, described in detail throughout this document, are underfunded and have been for years. Adequate funding is needed in order to ensure Oregon's natural resource legacy for future generations and to implement our shared vision for the future.

**Alternatives to the General Fund —** Stakeholders in Oregon are developing a number of ideas to stabilize agency budgets. Oregon's Water Resources Commission appointed a subcommittee in August 2010 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

**Recommended Action 13.B**
**Fund Water Resources Management Activities at State Agencies**

Examples of 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

must be logistically reasonable. The Governor requested a bill in 2013 that would have established an annual water right management fee. The Oregon Legislature introduced a similar bill in 2017. Neither one passed.

## Invest in Local or Regional Water-Planning Efforts

Planning is done successfully by ensuring that resources exist to help organize people and facilitate the conversation. It also takes resources to gather existing information and to complete new technical assessments that fill key knowledge gaps. In any planning effort, communication and outreach are fundamentally important and require investment of both time and resources.

In the coming years, an effective statewide Strategy will require planning efforts at the local level and regional level as well, such as place-based integrated water resources plans that can guide a series of actions and projects over time. Funding should continue to 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.

Other planning efforts should be supported as well. Water management and conservation plans, typically developed by larger public water suppliers, are planning tools that lay out steps to meet long-term water demands in the future. These plans can be costly and often small water systems lack the technical or financial capacity to develop these on their own. Providing funding to support development of municipal or agricultural water management and conservation plans could help those communities most in need.

Hazard mitigation planning is another tool to prepare for the next drought, flood, or other natural disaster. State, tribal, and local governments engage in hazard mitigation planning to identify risks and vulnerabilities and long-term, broadly supported strategies. A plan approved by the Federal Emergency Management Agency is required for receiving certain types of disaster assistance, including funding for mitigation projects.

Oregon's statewide hazard mitigation plan was approved in 2015 by the Federal Emergency Management Agency with enhanced status, making Oregon one of 12 states that can receive increased funds under the Hazard Mitigation Grant Program.[40]

Lastly, and separate from the examples noted above, it has been several decades since the state completed any sort of comprehensive revision to its basin plans. These plans, known as basin programs, exist as a set of administrative rules that establish water management policies and objectives for use of water in each basin. Some of the basin programs lack critical information, such as classifications for groundwater. Over the years, the Water Resources Department has been able to update some of its rules with minor revisions, but a more comprehensive update would require planning-level support.

**Recommended Action 13.C**
**Invest in Local or Regional Water-Planning Efforts**

Examples of how to implement this action:

- Continue to authorize and fund public and private investments in efforts such as place-based integrated water resources planning
- Provide funding to assist small water systems to develop water management and conservation plans
- Provide funding to support hazard mitigation planning (e.g. droughts, floods) at the local level
- Support river basin-planning updates

**Highlight Box**

**Planning for Future Water Needs for Rivers, Farms, and Cities**

The Deschutes River runs north, covering roughly 250 miles, and has numerous tributaries and three sections: the Upper Deschutes, which begins at Little Lava Lake and runs down to Bend; the Middle Deschutes, which extends to Lake Billy Chinook; and the Lower Deschutes, which flows to the Columbia River. The Deschutes is a spring-fed river that is known for its consistent streamflow fed by groundwater captured by the Cascades Mountains.

Management of the river has altered the timing and volume of streamflows. In the winter, Upper Deschutes River flows are reduced to fill the reservoir for the following water supply season. Nearly 90 percent of the streamflow from the Deschutes River in Bend is diverted through irrigation canals, which causes a reduction in streamflow in the Middle Deschutes. The Deschutes River supports agricultural producers in seven irrigation districts growing a variety of crops, ESA-listed fish species and amphibians, some of the fastest growing cities in Oregon, and world-class recreational opportunities.

Local partners in the Deschutes Basin have been working together for more than twenty years to identify creative ways to meet the water needs of rivers, farms, and cities. Prior studies assessed available water and anticipated needs through 2050 and found an overall need of 230,000 acre-feet of unmet demand each year for agricultural, instream flow, and municipal needs.

Building upon these studies, partners have initiated a larger basin planning effort in the Upper Deschutes Basin. A workgroup was formed in 2015 to support the basin study. Using a collaborative, consensus-based process, nearly 40 local, state, federal, and tribal partners are contributing to the study. The Study is supported by the Bureau of Reclamation's WaterSMART program and funded by federal and state funding sources. Private foundations and local partners are contributing significantly to the planning efforts as well.

A key focus of the planning study is not only water supply and demand, but taking into account climate change and analyzing how existing operations and infrastructure will perform under projected future conditions. Partners will develop and evaluate options for addressing water imbalances, considering various factors such as cost, environmental impacts, risks, and other criteria. Once the study is completed, partners hope that it will provide a broadly-shared vision for future water management options in the basin.

Find more information at: https://www.usbr.gov/pn/studies/deschutes/index.html

## Invest in Feasibility Studies

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 resources projects, ranging from infrastructure finance, to feasibility study grants for water supply, conservation, and reuse projects, and grants for watershed protection and restoration activities.

Local communities find it most 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.

One way Oregon can help with costs is to bridge the existing funding gap for feasibility studies. In 2008, the Water Resources Department initiated funding for Feasibility Study Grants, plus funds for the Umatilla Basin Aquifer Recovery Project. Since 2008, the Water Resources Department has provided approximately $4.8 million dollars of grant funding for 76 feasibility studies. These grant dollars have leveraged approximately $14.8 million dollars of matching funds and in-kind services, to determine the feasibility of water conservation, storage, and reuse projects.

**Recommended Action 13.D**
**Invest in Feasibility Studies for Water Resources Projects**

Examples of how to implement this action:

- Continue to provide Feasibility Study Grants to help evaluate the feasibility of water conservation, storage, and reuse projects
- Review and update the Feasibility Study Grants program based on lessons learned since 2008

Since the funding opportunity is nearly 10 years old, the state should conduct a programmatic review of the Feasibility Study Grant funding opportunity in order to understand and pursue program updates. In particular, the state should examine how this funding opportunity links to other funding opportunities for water projects.

## Invest in Project Implementation

In a 2016 survey of member cities, the League of Oregon Cities projected a need of $9 billion to address water and wastewater infrastructure needs over the next 20 years. 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, nor agricultural infrastructure investments that Oregon needs to undertake in the coming years.[41] The American Society of Civil Engineers (ASCE) has estimated similar costs. In its 2017 *Infrastructure Report Card for Oregon*, ASCE estimates Oregon's infrastructure need in the drinking water sector at about $5.6 billion and in the wastewater sector, about $3.89 billion, for a total of $9.49 billion.[42]

### Infrastructure Financing

There are several agencies and organizations in Oregon aimed at helping communities, districts, and businesses with the financial costs of water-related infrastructure. Business Oregon's Infrastructure Finance Authority 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 hundred million dollars have been awarded through these programs (see Figure 4-15). The Infrastructure Finance Authority just recently surpassed $300 million in water system funding to 173 projects across 31 Oregon counties through the Safe Drinking Water Revolving Loan Fund.

It also provides funds for technical assistance projects, such as developing or updating facility plans, water system master plans, engineering studies, preliminary or final designs for projects, and levee repair.

DEQ also administers a revolving loan fund, called the "Clean Water State Revolving Loan Fund," which provides low-interest loans to public entities for the planning, design, and construction of various projects that prevent or mitigate water pollution. This loan program typically provides $50 million annually for funding projects and has provided $1.2 billion in water improvement loans since 1990. Several projects are eligible for funding, including wastewater treatment facilities, irrigation improvements, stormwater facilities, brownfield projects, and water reuse projects, to name a few.

**Figure 4-15: Water and Wastewater Project Awards by Program (2007-2016)**

| Water Infrastructure | Wastewater Infrastructure | Water Tech. Assistance | Wastewater Tech. Assistance |
|---|---|---|---|
| Community Development Block Grants | | | |
| $22.2 million | $35 million | $2.98 million | $6.1 million |
| Water Fund (Includes Special Public Works Fund and Water/Wastewater Financing Program) | | | |
| $44.6 million | $115.9 million | $2.4 million | $1.4 million |
| Safe Drinking Water Revolving Loan Fund | | | |
| $219.7 million | n/a | $2.3 million | n/a |

**Drinking Water and Waste Water –** 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.

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. Some communities choose to finance part of their water and wastewater infrastructure capital costs by offering bonds to the market.

Congress authorized the Water Infrastructure Finance and Innovation Act (WIFIA) in 2014.[43] This new Federal fund will provide long-term, low-interest supplemental loans for large water infrastructure projects—those costing more than $20 million, or $5 million for communities smaller than 25,000 people.

**Rural Communities –** The U.S. Department of Agriculture's Rural Development program 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.

**Irrigation Districts –** The cost of delivering irrigation water 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 Irrigation Infrastructure –** Other funding sources for irrigation-related infrastructure exist at the state level as well. The Oregon Department of Fish and Wildlife offers both a cost-share program and tax credit to assist with installation of fish screening devices and passage facilities. 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.

## Funding for Watershed Restoration

Since 1999, the Oregon Watershed Enhancement Board (OWEB) has awarded more than 7,900 grants totaling more than $580 million to local volunteer efforts to keep water clean and habitats healthy. OWEB grants are primarily funded through Oregon Lottery, federal funds, and salmon license plate revenue. The majority of funds invested go directly to on-the-ground improvements of land and water such as native plantings, dam removals, irrigation efficiencies, fish passage, in-stream habitat enhancement, and land protected for future generations.

Some funds support a range of monitoring activities and grants, including baseline, compliance, status and trend, effectiveness, and validation monitoring. OWEB's investments have resulted in more than 4,600 miles of stream habitat improvements and nearly 6,000 miles of habitat made accessible for fish. Oregon consistently reports about the same length of stream mile restoration as Alaska, California, Idaho, Washington, and Pacific Northwest Tribes, combined.

On average, more than 90 cents out of every OWEB grant dollar supports local businesses, services, and suppliers. 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. According to a recent University of Oregon study, every $1 million that OWEB invests in habitat restoration creates 15-24 jobs in local communities.[44]

Oregon's watersheds also benefit from significant annual investments by the Bonneville Power Administration. In fiscal year 2015, BPA spent about $98 million on fish and wildlife programs in Oregon. Under the 2010 Willamette Wildlife Agreement, BPA began investing $144 million over 15 years for habitat protection in the Willamette River Basin.[45] These investments translate into an improvement in ecosystem conditions and enhancement of local economies.

**Focused Investment Partnerships –** Focused restoration efforts are an integral piece of OWEB's investment strategy. In 2015, the OWEB Board selected priority areas for targeted investments across the state. High performing partnerships working strategically within these priority areas are eligible to apply for Focused Investments Partnership grant funding. The funding is designed to help local partnerships scale their work strategically with multi-year, multi-million dollar investments in natural resource conservation and restoration work. In January 2016, OWEB selected six partnerships that include the Malheur Wildlife Refuge and associated wetlands, habitat for Greater Sage-Grouse in eastern Oregon, forestlands around Ashland, and habitats in the Willamette, Deschutes, and Grande Ronde river basins.

### Water Projects Grants and Loans

In 2013, the Legislature passed Senate Bill 839 creating the Water Supply Development Account.[46] Through this account, the Water Resources Department has been able to co-fund a WaterSMART Basin Study in the Deschutes River Basin with the U.S. Bureau of Reclamation and a reallocation feasibility study in the Willamette River Basin with the U.S. Army Corps of Engineers.

The state also awards grants and loans from the account through a competitive funding opportunity. These Water Project Grants and Loans provide funding to evaluate, plan, and implement instream and out-of-stream water resources projects. Since 2013, the Legislature has authorized $16.25 million.

In its first funding solicitation held in 2016, the Water Resources Department received 37 applications requesting nearly $51 million in grants and loans. The Water Resources Commission awarded approximately $9 million in funding to nine water projects. A second funding solicitation was held in early 2017. This time, the Department received 34 applications requesting $36.9 million in grants and loans. The state should continue to fund grants and loans for water projects and review and update the funding program, based on lessons learned.

**Recommended Action 13.E**
**Invest in Implementation of Water Resources Projects**

Examples of how to implement this action:

- Authorize bonds to finance these investments
- Ensure that basic maintenance needs continue to be eligible for grant and loan funding
- Advocate for continued state and federal funding for water and wastewater-related infrastructure
- Develop funding and technical support for low-income, small communities, and districts to maintain and operate water and wastewater-related infrastructure
- Continue funding and support for watershed restoration and Focused Investment Partnerships
- Continue to fund Water Project Grants and Loans
- Review and update the Water Project Grants and Loans program based on lessons learned

## Recommended Actions at a Glance

| Critical Issue | Recommended Action |
|---|---|
| Place-Based Efforts | 9.A Continue to Undertake Place-Based Integrated Water Resources Planning<br>9.B Coordinate Implementation of Existing Natural Resource Plans<br>9.C Partner with Federal Agencies, Tribes, and Neighboring States in Long-Term Water Resources Management |
| Water Management and Development | 10.A Improve Water-Use Efficiency and Water Conservation<br>10.B Improve Access to Built Storage<br>10.C Encourage Additional Water Reuse Projects<br>10.D Reach Environmental Outcomes with Non-Regulatory Alternatives<br>10.E Continue the Water Resources Development Program<br>10.F Provide an Adequate Presence in the Field<br>10.G Strengthen Oregon's Water Quantity & Water Quality Permitting Programs |
| Healthy Ecosystems | 11.A Improve Watershed Health, Resiliency, and Capacity for Natural Storage<br>11.B Develop Additional Instream Protections<br>11.C Prevent and Eradicate Invasive Species<br>11.D Protect and Restore Instream Habitat and Habitat Access for Fish and Wildlife<br>11.E Develop Additional Groundwater Protections |
| Public Health | 12.A Ensure the Safety of Oregon's Drinking Water<br>12.B Reduce the Use of and Exposure to Toxics and Other Pollutants<br>12.C Implement Water Quality Pollution Control Plans |
| Funding | 13.A Fund Development and Implementation of Oregon's Integrated Water Resources Strategy<br>13.B Fund Water Resources Management Activities at State Agencies<br>13.C Invest in Local or Regional Water-Planning Efforts<br>13.D Invest in Feasibility Studies for Water Resources Projects<br>13.E Invest in Implementation of Water Resources Projects |

# References


[1] Oregon Water Resources Department. 2015. Draft Guidelines: A Tool for Conducting Place-Based Integrated Water Resources Planning in Oregon. http://www.oregon.gov/owrd/LAW/docs/IWRS/2015_February_Draft_Place_Based_Guidelines.pdf

[2] Oregon Legislature. 2015. Senate Bill 266. https://olis.leg.state.or.us/liz/2015R1/Downloads/MeasureDocument/SB266/Enrolled

[3] U.S. Fish and Wildlife Service. 2008. 2008-2017 U.S. V. Oregon, Management Agreement. https://www.fws.gov/pacific/fisheries/hatcheryreview/Reports/snakeriver/SR--079.revised.2008-17USvOR_Mngmt_Agrmt.pdf

[4] U.S. Army Corps of Engineers and Bonneville Power Administration. 2013. U.S. Entity Regional Recommendation for the Future of the Columbia River Treaty after 2024. https://www.crt2014-2024review.gov/Files/Regional%20Recommendation%20Final,%2013%20DEC%202013.pdf

[5] State of Oregon and State of California. 2010. Klamath Basin Restoration Agreement: for the Sustainability of Public and Trust Resources and Affected Communities. https://klamathrestoration.gov/sites/klamathrestoration.gov/files/Klamath-Agreements/Klamath-Basin-Restoration-Agreement-2-18-10signed.pdf

[6] State of Oregon and State of California. 2010. Klamath Hydroelectric Settlement Agreement. http://216.119.96.156/Klamath/Klamath%20Hydroelectric%20Settlement%20Agreement%202-18-10signed.pdf

[7] U.S. Environmental Protection Agency. 2016. 2015 WaterSense Accomplishments. https://www3.epa.gov/watersense/docs/ws_accomplishments2015_3page_508.pdf

[8] League of Oregon Cities. 2015. Water, Wastewater, and Stormwater Rate Survey. http://www.orcities.org/Portals/17/Library/Water%20Rate%20Survey%203-17-15.pdf

[9] U.S. Department of Agriculture's National Agricultural Statistics Service. 2014. Farm and Ranch Irrigation Survey 2013. AC-12-SS-1. https://www.agcensus.usda.gov/Publications/2012/Online_Resources/Farm_and_Ranch_Irrigation_Survey/fris13.pdf

[10] U.S. Bureau of Reclamation. 2016. Water and Energy Efficiency Grants, Previous Grant Selections. Website. Accessed March 22, 2017. https://www.usbr.gov/watersmart/weeg/prev.html

[11] Oregon Water Resources Commission. 1992. Water Storage Policy and Principles.

[12] U.S. Congress (113th). 2014. HR 2640: Crooked River Collaborative Water Security and Jobs Act of 2014. https://www.govtrack.us/congress/bills/113/hr2640/text

[13] Oregon Water Resources Department. 2008. Above-Ground Potential Storage Project Search. http://apps.wrd.state.or.us/apps/planning/owsci/sw_project_search.aspx

[14] Clean Water Services. August 2017. Home Brew Competition to Feature Beer Made with Water from Tigard Wastewater Treatment Plant. Press Release. https://www.cleanwaterservices.org/newsroom/2017/home-brew-competition-to-feature-beer-made-with-water-from-tigard-wastewater-treatment-plant/

[15] MWH, Stantec, and Larry Walker Associates. 2016. Recommendations and Implementation Plan: NPDES Permitting Program Review. Prepared for the Oregon Department of Environmental Quality. http://www.oregon.gov/deq/FilterDocs/wqp-FinalReport.pdf

[16] State of Oregon. 1999. Oregon Plan for Salmon and Watersheds. Salem, Oregon. https://www.oregon.gov/OPSW/Pages/archived.aspx.

[17] Oregon Department of Agriculture. 2017. Agriculture Water Quality Plans Webpage. Accessed March 22, 2017. https://www.oregon.gov/ODA/programs/NaturalResources/AgWQ/Pages/AgWQPlans.aspx.

[18] Dahl, T.E. 1990. Wetlands Losses in the United States: 1780s to 1980s. U.S. Department of the Interior's U.S. Fish and Wildlife Service. Washington, D.C. https://www.fws.gov/wetlands/Documents/Wetlands-Losses-in-the-United-States-1780s-to-1980s.pdf

[19] Oregon Department of Fish and Wildlife. 2016. The Oregon Conservation Strategy. http://www.oregonconservationstrategy.org/.

[20] U.S. Fish and Wildlife Service. Beaver Restoration Guidebook: Working with Beaver to Restore Streams, Wetlands, and Floodplains. (June 30, 2015). https://www.fws.gov/oregonfwo/ToolsForLandowners/RiverScience/Documents/BRG%20v.1.0%20final%20reduced.pdf.

[21] U.S. Fish and Wildlife Services. 2017. Lower Klamath National Wildlife Refuge. Website. Accessed October 20, 2017. https://www.fws.gov/refuge/Lower_Klamath/about.html

[22] Thorne KM, Powelson KW, Bui TD, Freeman JY, Takekawa CM, Janousek CN, Buffington KJ, Elliott-Fisk DL. 2016. Assessing coastal manager science needs and disseminating science results for planning. Data Summary Report Prepared for the California and North Pacific Landscape Conservation Cooperatives. USGS Western Ecological Research Center: Vallejo, CA, 110. http://www.occri.net/media/1050/4ocar3_final_coast.pdf

[23] Oregon Board of Forestry. 2011. The Forestry Program for Oregon: A Strategy for Sustaining Oregon's Public and Private Forests http://www.oregon.gov/ODF/Board/Documents/BOF/fpfo_2011.pdf

[24] Oregon Legislature. 1971. Oregon Revised Statutes 390.805-940: Scenic Waterways Act. https://www.oregonlaws.org/ors/390.805

[25] Oregon Department of Fish and Wildlife and State Marine Board. 2016. Aquatic Invasive Species Prevention Program: Program Report. http://www.dfw.state.or.us/conservationstrategy/invasive_species/docs/AISPP_2016_Annual_Report.pdf

[26] Oregon Department of Geology and Mineral Industries. 2015. Fact Sheet on Hydraulic Fracturing in Oregon. https://olis.leg.state.or.us/liz/2017R1/Downloads/CommitteeMeetingDocument/129333

[27] U.S. Environmental Protection Agency. 2015. Environmental Justice (EJ) Screen. https://www.epa.gov/ejscreen

[28] Oregon Environmental Justice Task Force. 2016. Environmental Justice: Best Practices for Oregon's Natural Resources Agencies. https://www.oregon.gov/gov/policy/environment/environmental_justice/Documents/Oregon%20EJTF%20Handbook.v4.pdf

[29] Regional Water Providers Consortium. 2017. Source Water Protection Strategy. http://www.regionalh2o.org/sites/default/files/2017swpp-final.pdf

[30] Regional Water Providers Consortium. 2017. Source Water Protection Strategy. http://www.regionalh2o.org/sites/default/files/2017swpp-final.pdf

[31] Oregon Department of Environmental Quality. 2017. Drinking Water Protection Program Website. https://www.oregon.gov/deq/wq/programs/Pages/dwp.aspx

[32] Oregon Health Authority and Water Resources Department. 2015. Water Well Owner's Handbook: A Guide to Water Wells in Oregon. http://www.oregon.gov/owrd/pubs/docs/Well_Water_Handbook.pdf

[33] Oregon Department of Environmental Quality. 2012. Toxics Reduction Strategy: Descriptions of Actions. http://www.deq.state.or.us/toxics/docs/ToxicsStrategyNov28.pdf

[34] Office of the Governor, State of Oregon. 2012. Executive Order No. 12-05: Environmentally Friendly Purchasing and Product Design. https://www.oregon.gov/gov/Documents/executive_orders/eo_12-05.pdf

[35] Oregon Department of Agriculture, et al. 2011. Pesticide Management Plan for Water Quality Protection. https://www.oregon.gov/ODA/shared/Documents/Publications/PesticidesPARC/PesticideManagementPlanWaterQuality.pdf

[36] Barnes, K.K., et al. 2002. Water Quality Data for Pharmaceuticals, Hormones, and Other Organic Wastewater Contaminants in U.S. Streams, 1999-2000. For the U.S. Geological Survey. Open-File Report 02-94. https://toxics.usgs.gov/pubs/OFR-02-94/

[37] U.S. Environmental Protection Agency Region 10. 2014. Columbia River Toxics Reduction Working Group: Strategy for Measuring, Documenting, and Reducing Chemicals of Emerging Concern. https://www.epa.gov/sites/production/files/2014-07/documents/columbia-river-cec-strategy-july2014.pdf

[38] Oregon Department of Environmental Quality. 2011. Harmful Algal Bloom Strategy. http://www.deq.state.or.us/wq/algae/docs/AppendixE.pdf

[39] U.S. Environmental Protection Agency. 2012. Recreational Water Quality Criteria. https://www.epa.gov/sites/production/files/2015-10/documents/rwqc2012.pdf

[40] Federal Emergency Management Agency. 2017. Hazard Mitigation Plan Status. Website. Accessed March 27, 2017. https://www.fema.gov/hazard-mitigation-plan-status

[41] League of Oregon Cities. 2016. Out of Sight, Out of Mind: Funding Oregon's Water Infrastructure Needs. Local Focus. https://www.oregon.gov/owrd/LAW/docs/2016%2008%20LOC%20Infrastructure%20Needs.pdf

[42] American Society of Civil Engineers. 2017. Infrastructure Report Card - Infrastructure in Oregon. http://www.infrastructurereportcard.org/state-item/oregon/

[43] U.S. Congress. 2014. Water Infrastructure and Finance Innovation Act (WIFIA). Title V, Subtitle C. Sections 5021-5035. https://www.gpo.gov/fdsys/pkg/PLAW-113publ121/html/PLAW-113publ121.htm

[44] Nielsen-Pincus, Max and Cassandra Moseley. 2009. A Preliminary Estimate of Economic Impact and Job Creation from the Oregon Watershed Enhancement Board's Restoration Investments. Briefing Paper #13. University of Oregon's Ecosystem Workforce Program. Eugene, Oregon. http://ewp.uoregon.edu/sites/ewp.uoregon.edu/files/downloads/bp13.pdf

[45] Bonneville Power Administration and the State of Oregon. 2010. Willamette Wildlife Agreement. http://www.dfw.state.or.us/wildlife/willamette_wmp/docs/Memo_of_Agreement.pdf

[46] Oregon Legislature. 2013. Senate Bill 839. Salem, Oregon. https://olis.leg.state.or.us/liz/2013R1/Downloads/MeasureDocument/SB839

# Conclusion

As in 2012, the 2017 Integrated Water Resources Strategy relies on a foundation of science. Successfully infusing science into water-related decision-making requires information that is usable and accessible. Understanding our water resources, our demands upon those resources, and the coming pressures that affect our needs and supplies will help us meet our current and future instream and out-of-stream needs.

The reality of our national, state, and local boom and bust economic cycles will mean that implementation of Strategy may not be as robust or aggressive as desired. However, this should not curb Oregon's commitment to meeting our state's water needs, for both 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 suite of recommended actions to get us there.

Implementation of these recommended actions will occur in stages, with various public and private sector partners taking the lead.

## Steps Already Underway

Agencies that play a leadership role in Strategy will provide more details about the likely staffing needs, budget requirements, and timelines. Much of this will be developed in partnership with the Governor's Office and stakeholders as part of the Legislative process. Such detail will help signal the priorities and workload that agencies can realistically expect to undertake during the upcoming years. To be effective, agencies will need to publish regular progress reports, reflecting the actions taken by the Oregon Legislature, state agencies, and other partners to support implementation of the Integrated Water Resources Strategy.

Implementation of several recommended actions has already begun, with authorizations secured and funding already in place. Examples include the efforts to conduct additional groundwater investigations and improve water resource data collection and processing. These are basic building blocks that provide a solid foundation for decision-making and investments.

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. Funding for place-based planning, feasibility studies, and project implementation is legislatively approved through the end of the 2017-19 biennium.

Work is scheduled to continue on the water quality and public health front, with continuation of programs to ensure drinking water safety, to reduce exposure to toxics, and to implement water quality pollution control plans.

Oregon now also has a track record in water resources development with the establishment of a grant and loan program that has awarded investments in water resources projects since 2008.

## Steps Requiring Assistance from the Oregon Legislature

In order to position Oregon to better understand and meet its water needs now and into the future, the 2017 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 the capacity of the resource. These efforts also include improved monitoring of groundwater, surface water, and habitat through additional sites, improved instrumentations, continued technical training, 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 names 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 accurate groundwater and climate change information to local communities and planners, so that they can understand how potential changes in hydrological and precipitation patterns may affect their access to and management of water. New in this version is an emphasis on developing the proper statutory authorities, infrastructure, and communications systems to manage day-to-day operations as well as extreme events, such as drought, flood, and seismic events.

### Fourth, an improved ability to meet Oregon's current and future water resources needs

These recommendations call for continued efforts to help local communities conduct integrated water resources planning. They also call for continued investments in the state's grant and loan programs, notably in the management and protection of water for both consumptive and environmental needs. The recommendations point to a variety of traditional and non-traditional approaches to protect water quality, providing benefits to both public health and ecological health. Finally, the Strategy calls for a renewed commitment to identifying funding sources that can stabilize and support state agencies that have responsibility for water resources management. Recommended Action 13.B, for examples, lists those functions performed by state agencies that will require additional funds for successful implementation.

The next rendition of Oregon's Integrated Water Resources Strategy is due in 2022.

## Guiding Principles for Implementation

How Oregon carries out implementation is important as well. The State has made commitments to a number of guiding principles, including accountability, a balanced approach, collaboration, employing an open and transparent public process, reasonable cost, science-based approaches, streamlining, and other principles memorialized as part of the Strategy's development. Policy-makers responsible for furthering implementation have a duty to conduct the next phase as carefully as they did in the first. The guiding principles developed by the first Policy Advisory Group still ring true today.

**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.

**This page left intentionally blank.**

# Acronyms

| | |
|---|---|
| Ag | Agriculture |
| AgriMet | Agricultural Meteorology |
| AIS | Aquatic Invasive Species |
| ACFFOD | Amended and Corrected Findings of Fact and Order of Determination |
| ASCE | American Society of Civil Engineers |
| AR | Artificial Recharge |
| ASR | Aquifer Storage and Recovery |
| BiOp | Biological Opinion |
| CFS | Cubic Feet per Second |
| DEQ, ODEQ | Oregon Department of Environmental Quality |
| DOGAMI | Oregon Department of Geology and Mineral Industries |
| EAP | Emergency Action Plan |
| EPA | U.S. Environmental Protection Agency |
| ESA | Endangered Species Act |
| ET | Evapotranspiration |
| FEMA | Federal Emergency Management Agency |
| FTP | File Transfer Protocol |
| GDE | Groundwater Dependent Ecosystem |
| GWMA | Groundwater Management Area (DEQ designation) |
| IPCC | Intergovernmental Panel on Climate Change |
| LiDAR | Airborne Light Detection and Ranging |
| M&I | Municipal and Industrial |
| METRIC | Mapping Evapo-Transpiration using high Resolution and Internalize Calibration |
| MS4 | Municipal Separate Storm Sewer System |
| MW | Megawatt |
| NASA | National Aeronautics and Space Administration |
| NOAA | National Oceanic and Atmospheric Administration |
| NPDES | National Pollutant Discharge Elimination System |
| NPS | Nonpoint Source of Pollution |
| OAR | Oregon Administrative Rule |
| OCAR | Oregon Climate Assessment Report |
| OCCRI | Oregon Climate Change Research Institute |
| ORS | Oregon Revised Statutes |
| ODFW | Oregon Department of Fish and Wildlife |
| OWEB | Oregon Watershed Enhancement Board |
| PSP | Pesticide Stewardship Partnership |
| RISA | Regional Integrated Science and Assessments |
| TAF | Thousand Acre Feet |
| TMDL | Total Maximum Daily Load |
| UICs | Underground Injection Control Systems |
| USDA | U.S. Department of Agriculture |
| USGS | U.S. Geological Survey |
| WMCP | Water Management and Conservation Plan |

**This page left intentionally blank.**

# ACKNOWLEDGEMENTS


Documents of this scope and depth are the product of a talented team and a public who cares deeply about the future of water in Oregon. With gratitude for their times, expertise, and patience, we would like to thank:

**The IWRS Project Team:**

- Alyssa Mucken, Project Manager, and Brenda Bateman, OWRD
- Anna Pakenham Stevenson and Danette Faucera, ODFW
- Ray Jaindl and Margaret Matter, ODA
- Karen Tarnow, Smita Mehta, Wade Peerman, and Heather Tugaw, ODEQ

**The Policy Advisory Group (PAG):**

- Robert "Will" Collin
- Suzanne DeLorenzo
- Arlene Dietz
- Allan Elliott
- Ron Foggin
- Rebecca Geisen
- TJ Hansell
- Valerie Kelley
- Gayle Killam
- Craig Lacy
- Hiram Li
- Tracey Liskey
- Peggy Lynch
- Curtis Martin
- Craig Pope
- Brent Stevenson
- Stan van de Wetering
- Mary Wahl

**The State Agency Advisory Group:**

- Kyle Abraham, ODF
- Lauri Aunan, GNRO
- Jevra Brown, DSL
- Sadie Carney, DLCD
- Jeff Crook, ODOT
- Curtis Cude, OHA
- Kathie Dello, OSU-OCCRI
- Tom Elliot, ODOE
- Eric Hartstein, OWEB
- William Fletcher, ODOT
- Lisa Gaines, OSU-INR
- Rob Hallyburton, DLCD
- Karen Homolac, OBDD
- Ray Jaindl, ODA
- Todd Jarvis, OSU
- Jim Johnson, ODA
- Marian Lahav, DLCD
- Ian Madin, DOGAMI
- Ashley Massey, OSMB
- Jason McClaughry, DOGAMI
- Eric Metz, DSL
- Tom Pattee, OHA
- Alex Phillips, OPRD
- Ed Tabor, OBDD

**The Federal Liaison Group:**

- Crystal Ball, BPA
- Gary Ball, USFWS
- Tony Barber, US EPA
- Kevin Brice, USACE
- Andy Bryant, NOAA-NWS
- Caty Clifton, USFS
- Christina Davis-Kernan, USBR
- Greg Fuhrer, USGS
- Laura Hicks, USACE
- Kim Kratz, NOAA
- Rosy Mazaika, BPA
- Elena Nilsen, USGS
- Scott Oviatt, USDA-NRCS
- Julia Pierko, USBR
- Joel Salter, US EPA
- Brian Staab, USFS
- Dale Stewart, BLM
- Kathryn Warner, USACE
- Julee Welch, BPA

**The Use of Artwork:**

- April Waters, https://aprilwaters.com/resources/display/home
- Susan Luckey Higdon, http://www.susanluckeyhigdon.com/

**Other State Agency Contributors and Reviewers:**

- Kiara Goldtrap, DAS
- Carlee Justis, DAS
- Jacob Edwards, DOGAMI
- Wym Mathews, ODA
- Jim Johnson, ODA
- Aaron Borisenko, ODEQ
- Courtney Brown, ODEQ
- Dan Brown, ODEQ
- Larry Brown, ODEQ
- David Cole, ODEQ
- Paul Daniello, ODEQ
- Ron Doughten, ODEQ
- Paige Evans, ODEQ
- Kara Goodwin, ODEQ
- Pat Heins, ODEQ
- Rian Hooff, ODEQ
- Paul Kennedy, ODEQ
- Kevin Masterson, ODEQ
- Ryan Michie, ODEQ
- David Pray, ODEQ
- Krista Ratliff, ODEQ
- Phil Richerson, ODEQ
- Derek Sandoz, ODEQ
- Jill Seale, ODEQ
- Amy Simpson, ODEQ
- Sheree Stewart, ODEQ
- Deb Sturdevant, ODEQ
- Gil Wistar, ODEQ
- Greg Apke, ODFW
- Jamie Anthony, ODFW
- Rick Boatner, ODFW
- Kevin Goodson, ODFW
- Andrea Hanson, ODFW
- Tim Hardin, ODFW
- Ken Homolka, ODFW
- Aaron Jenkins, ODFW
- Tucker Jones, ODFW
- Ken Loffink, ODFW
- Alan Ritchey, ODFW
- Tom Stahl, ODFW
- Erick VanDyke, ODFW
- Joy Vaughan, ODFW
- Michele Weaver, ODFW
- Kaci Radcliffe, ODOE
- Warren Cook, ODOE
- David Farrer, OHA
- Kari Salis, OHA
- Jordan Beamer, OWRD
- Rianne BeCraft, OWRD
- Lanaya Blakely, OWRD
- Kathy Boles, OWRD
- Harmony Burright, OWRD
- Kris Byrd, OWRD
- Meredith Carine, OWRD
- Gerry Clark, OWRD
- Lorri Cooper, OWRD
- Kerri Cope, OWRD
- Diana Enright, OWRD
- Kate Fitzpatrick, OWRD
- Dwight French, OWRD
- Ivan Gall, OWRD
- Kyle Gorman, OWRD
- Mary Grainey, OWRD
- Lisa Graham, OWRD
- Bob Harmon, OWRD
- Mellony Hoskinson, OWRD
- Justin Iverson, OWRD
- Tony Janicek, OWRD
- Lisa Jaramillo, OWRD
- Chris Kowitz, OWRD
- Mike Ladd, OWRD
- Rachel LovellFord, OWRD
- Mike McCord, OWRD
- Larry Menteer, OWRD
- Keith Mills, OWRD
- Kim Ogren, OWRD
- Steve Parrett, OWRD
- Tom Paul, OWRD
- Racquel Rancier, OWRD
- Ann Reece, OWRD
- Cindy Smith, OWRD
- Ken Smith, OWRD
- Lisa Snyder, OWRD
- Jason Spriet, OWRD
- Ken Stahr, OWRD
- Jon Unger, OWRD
- Doug Woodcock, OWRD

**Highlight Stories:**

- "Community Led Water Quality Testing." Charlie Plybon, Surfrider Foundation. (Ch.1, Pg. 37).
- "Connecting Consumers to Salmon-Safe Products and Places." Dan Ken, Kevin Scribner and Anna Huttel, Salmon Safe. Photos: Phil Neumann, Mainstem Malt, and Ray Terrill, Flickr Creative Commons. (Ch. 2, Pg. 58).
- "Saving Water and Energy Go Hand in Hand." Robert Wallace and Randi Wallace, WyEast RC&D. Photo: Harmony Burright, OWRD. (Ch. 3, Pg. 69).
- "Green Infrastructure Projects Designed to Improved Water Quality." Photo: Eli Bonilla, Clean Water Services. (Ch. 3, Pg. 96).
- "Modernizing Oregon's Irrigation Infrastructure." Brett Golden, Farmers Conservation Alliance. (Ch. 4, Pg. 125).
- "Restoration for Compliance in the Rogue River and Beyond." Carrie Sanneman, Tess Malijenovsky, and Kristiana Teige Witherill, Willamette Partnership; Wade Peerman, ODEQ. Photo: The Freshwater Trust. (Ch. 4, Pg. 135).
- "Investing in Habitat for Native Migratory Fish in Oregon" Nicole Maness, Willamette Partnership. Photo: ODFW. (Ch. 4, Pg. 149).
- "Pesticide Stewardship Partnership in the Clackamas River Basin." Lisa Kilders, Clackamas SWCD. Photo: Jason Faucera, Clackamas SWCD. (Ch. 4, Pg. 159).
- "Planning for Future Water Needs for Rivers, Farms, and Cities." Bureau of Reclamation; Bea Armstrong and Kate Fitzpatrick, Deschutes River Conservancy. Photo: Deschutes River Conservancy. (Ch. 4, Pg. 169)

**The Oregon Board of Agriculture:**

- Barbara Boyer, Chair
- Pete Brentano
- Stephanie Hallock
- Bryan Harper
- Tracey Liskey
- Sharon Livingston
- Laura Masterson
- Marty Myers
- Tyson Raymond
- Luisa Santamaria

**The Environmental Quality Commission:**

- Sam Baraso
- Kathleen George
- Molly Kile
- Wade Mosby

**The Fish and Wildlife Commission:**

- Michael Finley, Chair
- Holly Akenson
- Laura Anderson
- Jim Bittle
- Bruce Buckmaster
- Bob Webber
- Gregory J. Wolley

**The Water Resources Commission:**

- John Roberts, Chair
- Bob Baumgartner
- Bruce Corn
- Eric Quaempts
- Meg Reeves
- Carol Whipple
- Ray Williams

Thomas M. Byler, Director
Oregon Water Resources Department

Richard Whitman, Director
Oregon Department of Environmental Quality

Curt Melcher, Director
Oregon Department of Fish and Wildlife

Alexis Taylor, Director
Oregon Department of Agriculture

# Oregon's Integrated Water Resources Strategy Framework

Final Revised Draft: 11-06-2017

OBJECTIVES — CRITICAL ISSUES — RECOMMENDED ACTIONS

## Understand Water Resources Today

**Objectives / Critical Issues:**
- Further Understand Limited Water Supplies & Systems (groundwater, surface water, and their interaction)
- Improve Water Quality & Quantity Information
- Further Understand Our Water Management Institutions

**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

## Understand Instream and Out-of-Stream Needs

**Objectives / Critical Issues:**
- Further Define Out-of-Stream Needs / Demands (i.e., diverted water)
- Further Define Instream Needs / Demands (i.e., left-in-place water)

**Understanding Oregon's Out-of-Stream Needs/Demands**
- 2A. Regularly update long-term water demand forecasts
- 2B. Improve water-use measurement & reporting
- 2C. Determine unadjudicated water right claims
- 2D. Authorize the update of water right records with contact information
- 2E. Regularly 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

## Understand the Coming Pressures That Affect Our Needs and Supplies

**Objectives / Critical Issues:**
- Economic Development
- Water & Energy
- Climate Change
- Extreme Events
- Population Growth
- Water & Land Use
- Water-Related Infrastructure
- Education & Outreach

**Water & Energy**
- 4A. Analyze the effects on water from energy development projects & policies
- 4B. Take advantage of existing infrastructure to develop non-traditional 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

**Extreme Events**
- 5.5A. Plan and prepare for drought resiliency
- 5.5B. Plan and prepare for flood events
- 5.5C. Plan and prepare for Cascadia subduction earthquake event

**Economic Development & Population Growth**
*(See Actions 2A and 3A)*

**Water & Land Use**
- 6A. Improve integration of water information into land use planning (and vice versa)
- 6B. Improve state agency coordination
- 6C. Encourage low-impact development practices and green infrastructure

**Water-Related Infrastructure**
- 7A. Develop and upgrade water and wastewater infrastructure
- 7B. Encourage regional (sub-basin) approaches to water and wastewater systems
- 7C. Ensure public safety/dam safety

**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

## Meet Oregon's Instream and Out-of-Stream Needs

**Objectives / Critical Issues:**
- Place-Based Efforts
- Water Management & Development
- Healthy Ecosystems
- Public Health
- Funding

**Place-Based Efforts**
- 9A. Continue to 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. Continue the water resources development program
- 10F. Provide an adequate presence in the field
- 10G. Strengthen water quantity & water quality permitting programs

**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 and wildlife
- 11E. Develop additional groundwater protections

**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 and implementation of Oregon's IWRS
- 13B. Fund water resources management activities at state agencies
- 13C. Invest in local or regional water planning effort
- 13D. Invest in feasibility studies for water resources projects
- 13E. Invest in implementation of water resources projects

## THE WATER RESOURCES 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 2010 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.

## 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.

**Errata Sheet: 11-06-17 Final Draft of Oregon's 2017 Integrated Water Resources Strategy**
December 7, 2017 (Version 2)

| **Introduction** | |
|---|---|
| Page # | Edit |
| P. 10 | Split 1st bullet into three separate bullets, one for each recommended action for 5.5A, 5.5B, and 5.5C. For all bullets, adjusted verb ending of all recommended actions to match existing text in later chapters. |
| P. 10 | Added an "a" before "Cascade subduction zone earthquake event" in Recommended Action 5.5C. Also made the change in Chapter 3 (P. 82 & P. 101) and the IWRS Framework (P. 173) |
| P. 11 | Inserted "can" before "improve our resiliency" to the 2nd paragraph under the section titled, "Collaborative Solutions." |
| P. 11 | Added "one-page Partner Stories and other text" to the 2nd paragraph under the section titled, "Collaborative Solutions." |

| **Chapter 1** | |
|---|---|
| Page # | Edit |
| P. 16 | Inserted "to" before "protect instream uses" in the 4th paragraph under the section titled, "Surface Water Availability." |
| P. 18 | Inserted "to have" before "additional TMDLs completed" in the 4th paragraph under the section titled, "Surface Water Quality." |
| P. 19 | Deleted "s" from "data exists" in the last paragraph above the section titled, "Ecosystem Health." |
| P. 22 | Added a reference to Figure 1-8 in the 1st paragraph under the section titled, "Monitor and Evaluate Surface Water Flows." |
| P. 24 | Deleted "s" on "defines" and "sets" in the 1st paragraph under the section titled, "Monitor and Evaluate Surface Water Quality." |
| P. 27 | Added "(s)" to "Outstanding Resource Water" in the last entry of the timeline. |
| P. 30 | Inserted "of these" after "The first" in the 3rd paragraph under the section titled, "Oregon's Instream Water Right Act." |
| P. 32 | Replaced titles, "Is it Safe to Swim?" and "Is it Safe to Eat the Fish" with one title called, "The Clean Water Act: Swimming and Fishing." |
| P. 34 | Replaced "7" with "seven" in the highlight box titled, "Community Led Water Quality Testing." |
| P. 34 | Added a period at the end of last sentence, 2nd paragraph, in the section titled, "Develop Decision Support Tools." |
| P. 35 | Replaced "over" with "more than" in the 6th paragraph under the section titled, "Encourage Inter-Agency Work." |

| **Chapter 2** | |
|---|---|
| Page # | Edit |
| P. 41 | Moved 2nd paragraph to the last paragraph in the section titled, "Contributions of Irrigated Agriculture." |
| P. 41 | Added a period at the end of the last sentence in the 1st paragraph of the section titled, "Contributions of Irrigated Agriculture." |
| P. 45 | Replaced mangled sentences with the following, "In 2013, the Oregon Legislature reinstated the position overseeing the state's Water-Use Reporting Program, as called for in the 2012 Integrated Water Resources Strategy. Reporting compliance rebounded from a low of 20 percent to about 70 percent consistently today." The change was made in the section titled, "Water Use Measurement and Reporting Program." |

| | *Chapter 2 continued* |
|---|---|
| P. 48 | Updated statistics in the 1st paragraph under the section titled, “Water-Related Recreation and Tourism” to read, “In its 2017 report, the Outdoor Industry Association (new endnote) estimated that all outdoor recreation in Oregon generates $16.4 billion annually in consumer spending, and supports 172,000 direct jobs--$5 billion in wages and salaries. These numbers are roughly similar to statistics in Nevada and Utah, but far below those in Arizona, Colorado, Washington, and California.” |
| P. 49 | Replaced “4th” with “fourth” and “8th” with “eighth” in 3rd paragraph under the section titled, “Water-Related Recreation and Tourism.” |
| P. 52 | Replaced last “mitigate” with “mitigation” in 4th paragraph under section titled, “Long-Term Instream Demand Forecast.” |

| **Chapter 3** | |
|---|---|
| Page # | Edit |
| P. 69 | Deleted “states have adopted” and “that” in the 1st sentence of section titled, “Water Rights and Climate Change.” |
| P. 70 | Replaced “and” with a comma after “wildfire seasons” in the 1st sentence under the section titled, “Critical Issue – Extreme Events.” |
| P. 71 | Added “This is” at the beginning of the bullet defining ecological drought. In same sentence, replaced “create” with “creates.” |
| P. 75 | Replace last sentence in 1st paragraph and Bullet #1 to read:<br>"To prepare far in advance of drought, the Drought Readiness Council sees the need for four important tools:<br>1) Providing Drought-Related Data. Decision-makers will be called upon to act on behalf of their communities, using available data in times of drought. The state needs to develop: indicators that signal stages of drought; information that documents the various impacts of drought; and the ability to identify areas that are vulnerable to drought." |
| P. 77 | Added “This is” at the beginning of the bullet defining riverine flooding. |
| P. 83 | Replaced “taking” with “taken” in the 3rd paragraph under the Goal 3 text. |
| P. 85 | Replaced “a population” with “populations” in the 1st sentence under the Goal 11 text. |
| P. 85 | Replaced “area” with “areas” in the 2nd paragraph under the section titled, “Information Inputs.” |
| P. 86 | Deleted “, however,” from the 1st sentence under the section titled, “Data Gaps.” |
| P. 90 | Replaced “impact” with “affect” in the 3rd sentence under the section titled, “Improve Oregon’s Levees.” |
| P. 93 | Replaced “properties” with “property” in Figure 3-12. |
| P. 93 | Added “Oregon's” to title of Figure 3-13. |
| P. 94 | Flipped order of “dam inspections” and “emergency access” and replaced “is” with “are” under the section titled, “Emergency Inspection after Extreme Events.” In the same section, added “can be” before “evacuated” in the last sentence. |
| P. 96 | Deleted “s” from “exists” in the 5th paragraph under the section titled, “Environmental Literacy.” |
| P. 100 | Replaced “and mitigated” with “and obstructions are mitigated” in the 3rd bullet about boating programs. |
| P. 100 | Deleted hyphen in “on-going” in the 1st sentence under the section titled, “Water-Related Research Needs.” |
| P. 97 | Replaced “will also serve” with “also serves” in the 1st sentence under the section titled, “Outdoor School.” |

| **Chapter 4** | |
|---|---|
| Page # | Edit |
| P. 109 | Replaced “resulting is” with “resulting in” in 2nd paragraph under the section titled, “Coordinate Existing Natural Resource Plans.” |
| P. 113 | Inserted “that” after “shows” in the 4th paragraph under the section titled, “Water Conservation within Agriculture.” |
| P. 116 | Replaced “do” with “conduct” in the 1st paragraph under the section titled, “Future Water-Use Efficiency and Conservation Programs.” |

| | |
|---|---|
| | *Chapter 4 continued* |
| P. 116 | Changed title to, "Removing Irrigated Landscapes." |
| P. 116 | Changed title to, "Net Zero Water Systems." |
| P. 117 | Deleted "options" in 2nd paragraph under the section titled, "Improve Access to Built Storage." |
| P. 119 | Replaced "the dam" with "dams" in last sentence under the section titled, "Evaluating Storage Instructure." |
| P. 121 | Replaced "manufacturing" with "manufacturer" in the 3rd bullet of the series. |
| P. 125 | Deleted "knowledge of" from 3rd paragraph under the section titled, "Provide an Adequate Presence in the Field." |
| P. 126 | Deleted "in" from "in other Districts" under the section titled, "Training." |
| P. 132 | Deleted "birds" in the last sentence under the section titled, "Estuaries." |
| P. 132 | Deleted "to" before "source water quality" in 4th the bullet of Recommended Action 11.A. |
| P. 133 | Added "and associated wetlands" following "its tributaries" in the 1st paragraph under the section titled, "Outstanding Resource Waters." |
| P. 137 | Added "just" before "providing" in 1st bullet of the highlight box. |
| P. 143 | Deleted "[new sub-title]" from the section titled, "Source Water Protection." |
| P. 143 | Added "than" after "more" in 1st bullet under the section titled, "Source Water Protection." |
| P. 149 | Deleted the comma and added "and" before "recent" in the 5th paragraph, last sentence under the section titled, "Monitoring Recreational Waters and Informing the Public." |
| P. 151 | Inserted "the" before "remaining" in 3rd paragraph under the section titled, "Implement Water Quality Pollution Control Plans." |
| P. 154 | Inserted a comma after "flood" and replaced "flood" with "floods" in the 9th bullet under the section titled, "Fund Water Resources Management at State Agencies." |
| P. 159 | Inserted "IFA" at beginning of title in Figure 4-15. |
| P. 160 | Replaced hyphen with "to" in "15-24 jobs..." in the 3rd paragraph under the section titled, "Funding for Watershed Restoration." |
| P. 161 | Plan to add and fill in sentence, "In December 2017, the Commission awarded ___million in funding to ___water projects." (Pending the outcome of Agenda Item D.) |

| **Conclusion** | |
|---|---|
| Page # | Edit |
| P. 166 | Deleted "s" in "for examples..." in the last paragraph under the section titled, "Fourth, an improved ability to meet Oregon's current and future water resources needs." |

| **Acronyms** | |
|---|---|
| Page # | Edit |
| P. 169 | Added additional acronyms: BLM, BPA, DAS, DLCD, DSL, GNRO, INR, NRCS, NWS, OBDD, ODA, ODOE, ODF, ODOT, OHA, OPRD, OSMB, OSU, OWRD, USACE, USBR, USEPA, USFS, USFWS |

| **Acknowledgements** | |
|---|---|
| Page # | Edit |
| P. 171 | Added acronyms "(AAG)" and "(FLG)." |
| P. 171 | Removed two duplicate names from AAG list. |
| P. 171 | Adjusted alphabetical order of staff from ODA, ODFW, and ODOE. |

| **Framework** | |
|---|---|
| Page # | Edit |
| P. 173 | Added a sub-title to the IWRS framework. |

**DEPARTMENT OF THE ARMY**
CORPS OF ENGINEERS, PORTLAND DISTRICT
PO BOX 2946
PORTLAND OR 97208-2946

04 DEC 2017

SUBJECT: Oregon's Integrated Water Resources Strategy

Oregon Water Resources Commission
c/o Oregon Water Resources Department
North Mall Office Building
725 Summer Street NE, Suite A
Salem, OR 97301

Dear Chair Roberts:

The U.S. Army Corps of Engineers (Corps) appreciates the opportunity to serve as a Federal Liaison Group member for Oregon's Integrated Water Resources Strategy (IWRS). Several of the recommended actions laid out in the IWRS represent shared priorities and are supported by various programs administered by the Corps.

Through our general investigation study program, the Corps has spent the past several years working very closely with the Water Resources Department on the Willamette Basin Review feasibility study, helping to improve access to water supplies for meeting future needs in the Willamette River Basin. Drought planning and response is another area of mutual interest for our agencies. The Corps currently participates in the State's Water Supply Availability Committee, assisting the Department with tracking and monitoring water supplies throughout the year.

As chair of Silver Jackets, an inter-agency team that emphasizes integration of flood risk programs and projects, we have appreciated the Department's participation over the years. The Corps also plays a significant role in dam safety, floodplain management, and reservoir operations, all functions recognized in the most recent update of the IWRS. As the owner and operator of 19 dams and multi-purpose reservoirs, we know that successful management occurs through close coordination with our partners, including the State of Oregon.

The Corps wishes to acknowledge the considerable effort that went into developing the 2017 Integrated Water Resources Strategy. In the coming years, we look forward to working with the Department, as we have in the past, to further implementation efforts around water management issues of mutual interest.

Sincerely,

Kevin J. Brice

Kevin J. Brice, P.E., PMP
Deputy District Engineer
for Project Management

# United States Department of the Interior

U. S. GEOLOGICAL SURVEY
OREGON WATER SCIENCE CENTER
2130 SW Fifth Avenue
Portland, Oregon 97201

December 6, 2017

John Roberts, Chair
Oregon Water Resources Commission
c/o the Oregon Water Resources Department
North Mall Office Building
725 Summer St. NE, Suite A
Salem, OR 97301

Dear Chair Roberts:

The U.S. Geological Survey (USGS) appreciated the opportunity to be involved in the development of the 2017 Integrated Water Resources Strategy (Strategy). The USGS supports this comprehensive framework to address water issues facing Oregon.

The USGS's Oregon Water Science Center partners with federal, state, and local agencies in collecting streamflow, groundwater level, and water quality data to support many of the critical issues contained in the 2017 Strategy. Our office conducts studies, often in collaboration with state agencies, to assess groundwater and surface water availability, evaluate water quality in streams and aquifers, understand consumptive water use, and optimize water use and reservoir operations to minimize deleterious effects to water quantity and quality. We support the Strategy's continued emphasis in these areas. We are prepared to continue our collaboration with Oregon Water Resources Department (OWRD) on groundwater studies in the future as stated in the Strategy.

The revised Strategy now includes several new important issues, such as drought and flooding, resiliency to earthquakes and tsunamis, and safety of levees and dams. USGS supports study of these issues. Continued or expanded state involvement with these threats to infrastructure and lives will greatly help the ongoing collaboration between the USGS and OWRD on drought as part of its water availability committee; with OWRD and the National Weather Service on flooding with our streamgaging and modeling capabilities; with state and local agencies in mapping faults, and modeling coastal inundation and resiliency from tsunamis; and with U.S. Army Corps of Engineers and local agencies to evaluate extreme flow events that may affect dam and levee safety. We support the adoption of the 2017 Integrated Water Resources Strategy, recognizing that addressing these issues is integral to any comprehensive strategy that aims to meet the water and public safety needs of the state in the future.

Sincerely,

Acting for James D. Crammond
Director

cc: Tom Byler, OWRD
Alyssa Mucken, OWRD

**United States Department of Agriculture** **Forest Service** **Pacific Northwest Region**

**1220 SW Third Avenue (97204)**
**P.O. Box 3623**
**Portland, OR 97208-3623**

**File Code:** 2500; 3500
**Date:** November 21, 2017

Mr. Tom Byler
Director
Oregon Water Resources Department
725 Summer Street NE, Suite A
Salem, OR 97301

Dear Mr. Byler:

Thank you for the opportunity to participate and engage in the 2017 Integrated Water Resource Strategy (IWRS). A recent IWRS Federal Liaison group meeting in August 2017 provided an update on the April 2017 public review draft and addressed many important topics of mutual interest such as improving drought resiliency and place-based planning. Adoption of the 2017 IWRS by the Water Resources Commission will advance these and many other important strategies and actions to benefit the people and resources in Oregon.

We will continue to coordinate and seek opportunities to work collaboratively with the Oregon Water Resources Department as the state moves forward implementing the 2017 IWRS. Caty Clifton, Regional Water Quality and Water Rights Program Manager, cclifton@fs.fed.us, 503-808-2696 and Sherry Fountain, Acting Regional Forester's Representative to Oregon, orro_liaison@fs.fed.us, 503-250-4430 are available to discuss opportunities to continue our participation and engagement.

Sincerely,

for John D. [signature]

JAMES M. PEÑA
Regional Forester

cc: Alyssa Mucken (OWRD); Marie-Louise Smith, Caty Clifton, Sherry Fountain

USDA

United States Department of Agriculture

Natural Resources Conservation Service

1201 NE Lloyd Blvd.
Suite 900
Portland, OR 97232
503-414-3200

October 30, 2017

Mr. Tom Byler
Director
Oregon Water Resources Department
725 Summer Street NE, Suite A
Salem, OR 97301

RE: 2017 Integrated Water Resources Strategy

Dear Mr. Byler:

The Natural Resources Conservation Service (NRCS) appreciates the opportunity to participate and discuss important topics relating to the development of Oregon's Integrated Water Resources Strategy (IWRS). The adoption of the 2017 IWRS by the Water Resources Commission will represent a landmark in the state's effort to continue to develop and achieve change in strategies that benefit all citizens, stakeholders, and resources in Oregon.

NRCS recognizes the importance of the collaborative and cooperative processes required to develop, establish, and maintain coordination between agencies, organizations, and individuals in order to complete the document. NRCS looks forward to continuing to work with OWRD as the state works toward implementation of the IWRS.

Sincerely,

Ronald Alvarado

RONALD ALVARADO
State Conservationist