CHAPTER 1

UNDERSTAND WATER RESOURCES TODAY

Photo: Rich Marvin, OWRD

Crooked River near Prineville, Crook County

Limited Water Supplies & Systems

Water Management Institutions

Water Quality & Water Quantity Information

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

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

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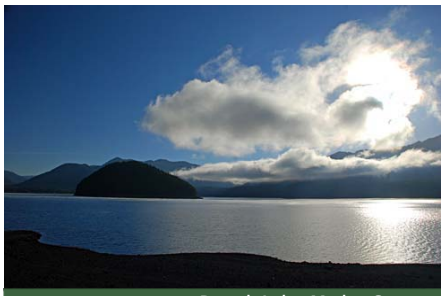
Owyhee River at Leslie Gulch, Malheur County

Benham Falls, Deschutes River, Deschutes County


Detroit Lake, Marion County

Photos: Gary Halvorson, Oregon State Archives

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

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

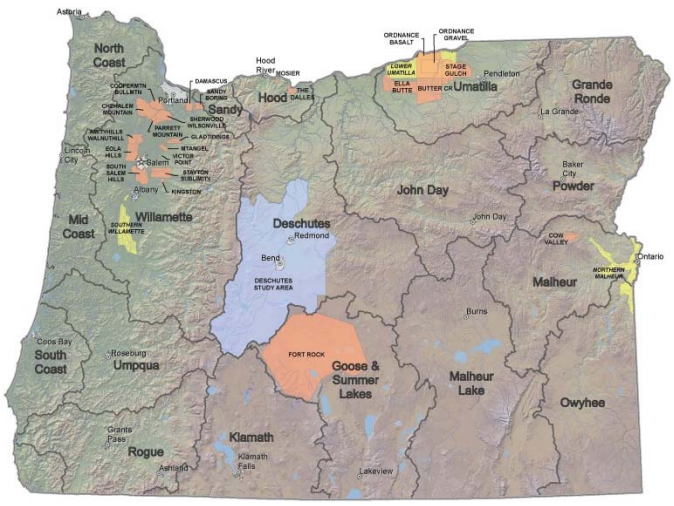
The Status of Oregon's Water Resources

Groundwater

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

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

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



Areas with Known Groundwater Issues
(Quality & Quantity)

DEQ GW Management Area
OWRD Administrative Basin
OWRD GW Restricted Area
WRD/USGS Deschutes GW Study Area

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

Surface Water and Groundwater Interactions

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

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

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

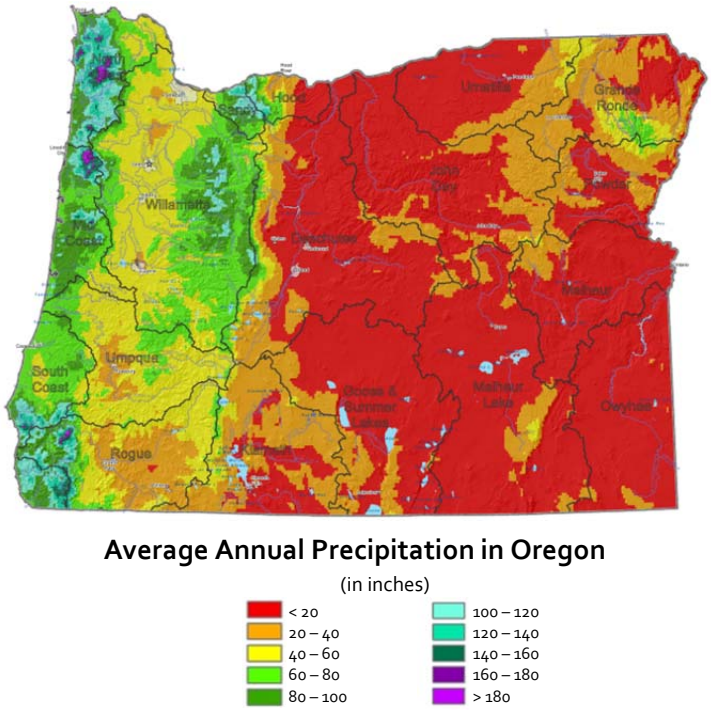
Generally, the Water Resources Department denies or limits groundwater applications in instances where use from a groundwater aquifer can substantially interfere with a surface water source that is already fully appropriated. One example of conjunctive management stems from a 2001 study conducted by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

Precipitation

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

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

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

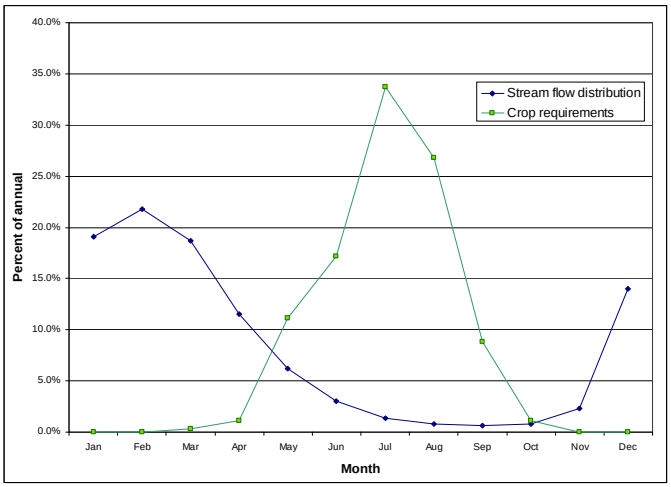


Timing—Supply versus Demand

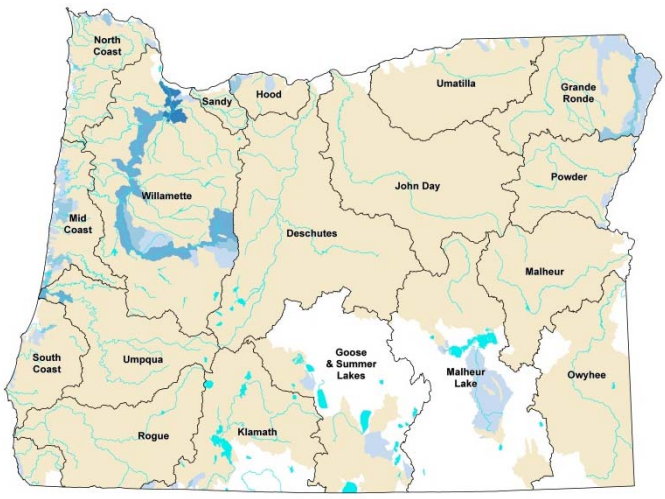
The arrival of precipitation in Oregon, whether by rain or snow, typically occurs between the months of October and May. This stands in stark contrast to the months in which water demands are at their peak for most uses.

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

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



Typical Timing of Streamflow vs. Demand in Oregon



August Available Streamflow

Streamflow estimated at 80% Exceedance

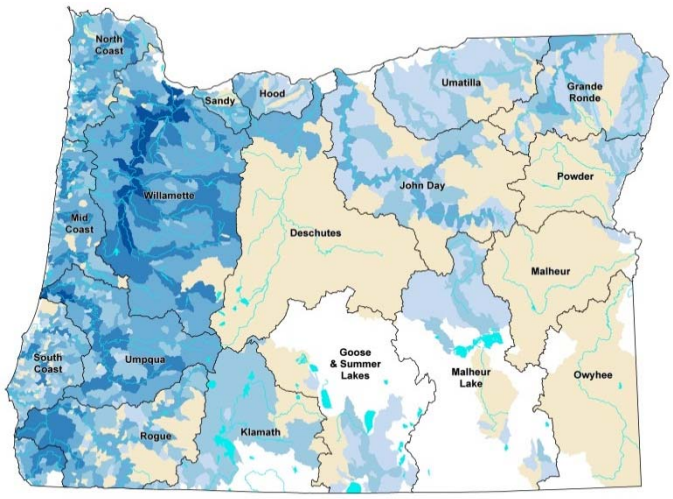
- No data
- No water available
- 0.1 – 10 cfs
- 10.1 – 100 cfs
- 100.1 – 1,000 cfs
- 1,000.1 – 10,000 cfs
- 10,000.1 cfs or greater

Water Availability

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

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

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



January Available Streamflow

Streamflow estimated at 50% Exceedance

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

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

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

How We Use Water

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

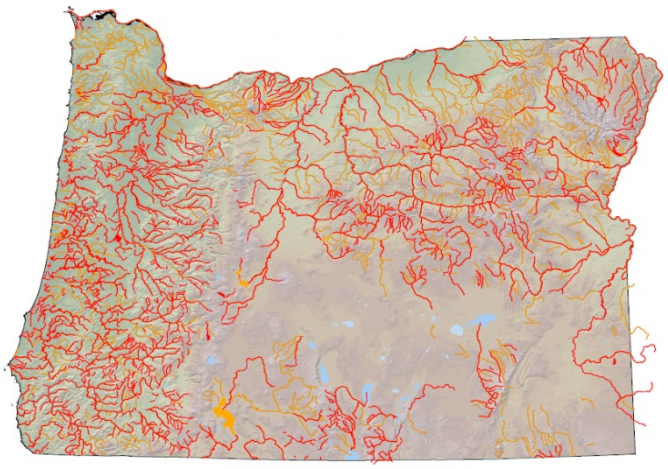
The water that is not diverted totals about 91 million acre-feet. A portion of this water, approximately 19 million acre-feet, is protected by 1,400 instream water rights held in trust by the State. The water that stays instream and in the ground sustains aquatic species and ecosystems. Instream flows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

Water Quality

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

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

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



Oregon's Impaired Waters (2004/2006)

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

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

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

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

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

Impaired Water Quality and Ecosystem Conditions

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

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

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

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

CRITICAL ISSUE: FURTHER UNDERSTAND OUR WATER MANAGEMENT INSTITUTIONS

Columbia River, Umatilla County

Alsea Falls in the Coast Range, Benton County

Ochoco Reservoir, Crook County

Photos: Gary Halvorson, Oregon State Archives

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

Timeline of Oregon's Leadership Role in Water Resource Management

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

Timeline, continued…

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

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

Understanding How Water Quantity is Managed

Doctrine of Prior Appropriation

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

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

Permits

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

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

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

Understanding How Water Quality is Protected

The Clean Water Act

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

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

Permits

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

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

Other Relevant Water Quality Laws

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

Understanding How Ecosystems Are Protected

The Endangered Species Act (ESA)

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

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

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

Other Relevant Ecosystem Laws

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

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

Understanding How Instream Flows Are Protected

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

Oregon's Scenic Waterway Act

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

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

Oregon's Instream Water Rights Act

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

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

Understanding How Public Health Is Protected

The Safe Drinking Water Act

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

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

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

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

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

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

Testing Water Quality in Private Drinking Water Wells

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

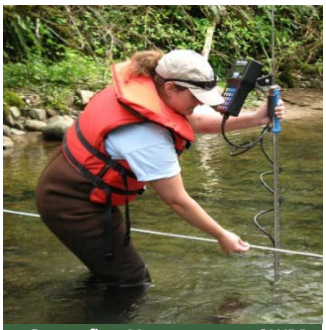
In 2004, DEQ obtained a grant from the EPA to create a database and summarize real estate transaction data. The data provides a broad overview of groundwater quality in the state, as well as some specific observations about nitrate levels. Most domestic well tests (82 percent) show nitrate levels below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

CRITICAL ISSUE: IMPROVE WATER QUALITY AND WATER QUANTITY INFORMATION

Aquatic Species Surveying, ODFW

Water Quality Sampling, ODEQ

Identifying Well Locations, OWRD


Streamflow Measurements, OWRD

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

Groundwater Investigations

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

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

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

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

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

Recommended Action 1.A
Conduct Additional Groundwater Investigations

How to implement this action:

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

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

Groundwater Administrative Areas

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

Locating and Documenting Wells

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

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

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

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

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

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

The Role of Data in Decision Making

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

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

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

Monitoring and Evaluating Groundwater Levels

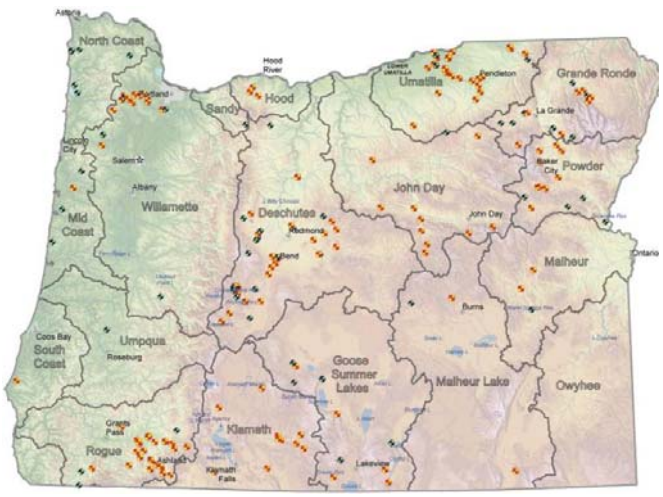
Accurate well location and water level data measured at state observation wells and miscellaneous project wells are critical to help assess groundwater resources. Prior to conducting groundwater studies in a basin, it is necessary to establish long-term water level data sets to accurately evaluate climatic,

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

Monitoring and Evaluating Surface Water Flows

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

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



OWRD Gaging Stations

Active Near real time

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

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

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

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

Monitoring and Evaluating Surface Water Quality

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

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

Monitoring and Evaluating Groundwater Quality

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

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

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

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

How to implement this action:

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

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

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

Monitoring and Evaluating Habitat Conditions and Watershed Functions

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

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

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

Expand Use of LiDAR Technology

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

Russell Faux,
Watershed Sciences, Inc.

Use of Airborne Remote Sensing

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

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

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

Enhancing Data Coordination

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

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

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

How to implement this action:

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

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

Making Water-Related Information Available

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

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

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

Investing in Scientific Modeling Tools

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

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

Investing in Inter-Agency Work

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

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

Recommended Actions at a Glance

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