

Monitoring Strategy for Oregon's Waters

An Inter-Agency Approach

Oregon Stream Team



2017

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Executive Summary

This water monitoring strategy for Oregon's waters developed by an Oregon inter-agency STRategic Enterprise Approach to Monitoring (STREAM) Team, combines state agency information into a single reference document to promote coordination and collaboration. The purpose of this document is to help natural resources agency scientists identify and collect the right information needed to inform policy-makers about emerging water issues, the status and trends of Oregon's waters, and the effectiveness of current agency actions.

This strategy identifies the current authorities, monitoring strategies, and programs of Oregon's seven primary natural resource agencies working to monitor the status and trends of Oregon's fresh waters, in lakes, reservoirs, rivers, streams, estuaries and groundwater, along with the aquatic life they support. The agencies included here are the Department of Agriculture (ODA), the Department of Environmental Quality (DEQ), the Department of Fish and Wildlife (ODFW), the Department of Forestry (ODF), the Water Resources Department (WRD), the Department of State Lands (DSL), and the Watershed Enhancement Board (OWEB). Also included are two integrated university based institutes: the Institute for Water and Watersheds (IWW) at Oregon State University, and the Institute for Natural Resources (INR) at Oregon State University and Portland State University.

While the authorities, monitoring strategies and programs of the seven agencies vary, they overlap in their focus on effectiveness monitoring. Collectively, the agencies have extensive programs to regulate the use of, impacts to, and restoration of water and aquatic systems in the state. The majority of their monitoring has been designed to develop plans or programs and to assess how effective these programs and actions are. This strategy begins to identify opportunities for agencies to work together to plan, collaborate and share environmental data. The results of this ongoing coordination will enhance efficiencies, provide more complete water data and create economies of scale.

As current environmental data systems are replaced and new monitoring programs are established, coordination will increase the efficiency of monitoring efforts. For example, statewide stream temperature and flow monitoring is a key information need and a gap in monitoring coordination. A major need is to understand water quality and quantity trends, including a coordinated statewide stream temperature and flow monitoring program that would (1) inventory existing information, (2) identify gaps, (3) establish new monitoring sites, and (4) develop a common storage solution for continuous data to facilitate mapping of current and future resource states through stream network monitoring tools. Temperature and flow are cross-cutting indicators important to many of the natural resource agencies, presenting an immediate opportunity for coordination and efficiency gains. Web-based data tools offer opportunities for agencies to coordinate their ongoing monitoring efforts for temperature and flow. The STREAM Team offers an important venue for facilitated inter-agency discussion about common questions, and to facilitate monitoring and environmental data coordination to ensure that data tools and other supporting products remain relevant to these questions.

Introduction

High quality environmental monitoring data provides a foundation for making sound decisions that impact Oregon's water resources. In 2012, Oregon developed the state's first Integrated Water Resources Strategy (IWRS 2012) which identified the need to improve access to water quality and water quantity monitoring information as a "critical issue". This strategy provides specific recommendations and outlines an over-arching inter-agency framework to address these issues. Oregon's natural resources agencies collect a wide variety of environmental data on our shared water resources. These data are used to assess compliance with regulations, evaluate the effectiveness of restoration and conservation projects designed to protect and restore stream flows, water quality, and aquatic life, and to identify issues of emerging concern.

This monitoring strategy was developed by Oregon's inter-agency STRategic Enterprise Approach to Monitoring (STREAM) Team. It examines the roles, responsibilities and questions state natural resource agencies have related to water monitoring activities. This information was compiled to help agency scientists identify and collect the information needed to better inform policy-makers about emerging issues of concern, the status and trends of Oregon's waters, and the effectiveness of current agency actions and programs.

The different authorities, jurisdictions and missions of Oregon's natural resources agencies often require unique data to interpret compliance with agency rules, programmatic effectiveness and success in accomplishing specific mission objectives. At the same time, there are opportunities to share environmental data between our agencies while creating efficiencies in the way data is collected and shared. The success of any individual agencies' environmental mission is linked to the success of all partners. As agencies and organizations strive to understand the status and trends of our waters and aquatic life, and the effectiveness of programmatic activities, we need evidence that our collective efforts are working, complementary and efficient to insure plentiful, clean water is available to meet the needs of current and future generations.

This strategy provides an overview of the current strategies, authorities and programs of Oregon's natural resource agencies use in order to monitor Oregon's fresh waters, in lakes, reservoirs, rivers, streams, estuaries and groundwater, along with the biota they support. Each agency provides a short summary that includes information on each of the following:

- The federal and/or state rules that provide authority to monitor;
- The primary information needs or questions addressed by the strategy;
- Where on the geographic and or political landscape the strategy applies;
- How the agency goes about implementing their strategy; and
- Gaps in the strategy or in agency monitoring that need to be addressed.

(e.g., elevation, soils, climate, hydrology, wildlife, fire, floods) and historical and current human influences that are beyond the Program’s statutory authority (e.g., stream channelization, roads, modified flows, previous land management). The goal is for Oregon’s agricultural landowners to provide the water quality functions (shade, streambank stability, and filtration of pollutants) produced by SCV along streams flowing through agricultural lands.

Area Plans

Area Plans provide guidance for addressing water quality related to agricultural activities in each Management Area. Area Plans are non-regulatory and unenforceable. Each Area Plan identifies strategies to prevent and control water pollution from agricultural lands through a combination of outreach programs, suggested land treatments, voluntary management activities, funding, compliance with regulatory Area Rules, and monitoring.

The goal of each Area Plan is to *prevent and control water pollution from agricultural activities and soil erosion and achieve applicable water quality standards*. This goal is the same as the Program’s goal. This goal is accomplished through helping landowners make on-the-ground changes, resulting in improved upland and streamside conditions that will protect water quality (Figure 2). ODA and LACs will use the monitoring data provided at each biennial review as part of the adaptive management process to review and evaluate progress, and determine what additional efforts, if any, are needed. These may include work in prioritized watersheds and adoption of appropriate management practices.

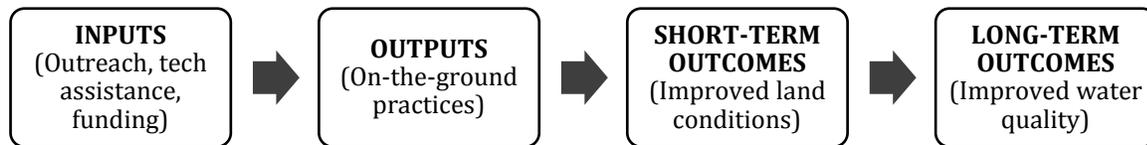


Figure 2. Process for meeting the Area Plan/Program GOAL

Area Rules

Area Rules (Oregon Administrative Rules 603-095-0000 through 3900) require that landowners perform actions as necessary to prevent and control pollution from agricultural activities and soil erosion.

All Management Areas have at least two rules: a waste rule and a streamside vegetation rule. Some Area Rules have additional rules that are specific to that Management Area.

Waste Rule

All agricultural landowners must comply with a Waste Rule by not polluting ground or surface water, discharging wastes into waters of the state, or placing any wastes in a location where they are likely to enter waters of the state (ORS 468B.025). *Wastes* include excess soil, manure, fertilizer, or other substances that can pollute water. *Waters of the state* can include ponds, groundwater, canals, ditches, and rivers.

Streamside Vegetation Rule

At a minimum, all agricultural landowners must comply with a streamside vegetation rule by allowing vegetation to establish and grow along:

- Streams that flow all year (perennial streams), to provide shade, stabilize banks, and filter out pollutants from overland flows.
- Streams that flow part of the year (intermittent streams), to stabilize banks and filter out pollutants from overland flows.

Agency Specific Monitoring and Information Needs

The Program is currently focused on showing progress via monitoring. The Program primarily focuses on evaluating land conditions that are under the control of landowners, and also collects in-stream water quality data under specific circumstances. The Program has also developed a long-term plan to monitor stream temperatures related to changes in streamside vegetation.

The Program's key monitoring questions, to determine status and trends, are:

A. Inputs and Outputs

1. What activities are being done to help achieve desired land conditions and water quality?

B. Short-term Outcomes: Compliance and Land Conditions

2. What percent of agricultural uplands are in compliance with the Waste Rule?
3. What percent of stream miles on agricultural lands are in compliance with the Streamside Vegetation Rule?
4. What percent of agricultural uplands have land conditions that protect water quality?
5. What percent of stream miles on agricultural lands have vegetation that provides water quality functions equivalent to site-capable vegetation?
6. What percent of stream miles on agricultural lands have conditions that will likely prevent site-capable vegetation from providing desirable water quality functions?

C. Long-term Outcomes

7. What are water quality status and trends in agricultural areas?
8. How are water quality status and trends related to changes in agricultural upland and streamside vegetation conditions?

Status and Implementation of Agency Monitoring Strategy

The ODA Water Quality Program has just updated its monitoring strategy. It has identified the key monitoring questions presented above and is developing methods and metrics to answer the questions. The key questions, metrics, and methods are likely to evolve slightly over time as they are discussed and further refined.

Data and Information Gaps

ODA relies on available information to implement the Program and measure progress. However, data gaps lead to many assumptions and limitations. ODA has identified gaps (Table 3) that limit our ability to effectively answer our key monitoring questions.

Table 1. Data gaps identified by ODA and key monitoring questions being affected

Gaps	Questions
An accurate, detailed statewide GIS layer of agricultural lands	Q2-8
An accurate, detailed statewide GIS layer of perennial and seasonal streams	Q2-8
An accurate, detailed statewide GIS layer of site-capable streamside vegetation communities	Q3, 5-6, 8
Comprehensive documentation of conservation activities implemented at the Management Area scale	Q1
Sufficient data to characterize agricultural water quality in most Management Areas	Q7-8
Adequate water quality data for seasonal streams	Q7-8
An affordable, repeatable, automated method for assessing the characteristics of streamside vegetation at the landscape scale	Q3, 5-6, 8
An assessment method that characterizes land conditions on uplands that is applicable across the state	Q4
An assessment method that relates existing streamside vegetation to site-capable vegetation	Q5
An assessment method that identifies stream segments on agricultural lands that have conditions that likely prevent SCV from providing desirable water quality functions	Q6
Adequate flow data for perennial and seasonal streams to calculate loads	Q7-8

Oregon Department of Environmental Quality

Geographic and Jurisdictional Responsibilities

The Department of Environmental Quality (DEQ) is authorized and in certain cases mandated to conduct water quality monitoring under Oregon Revised Statutes (ORS).

- ORS 468.05: (1) (b) and ORS 468.05 (1) authorize the department to conduct monitoring.
- ORS 468B.110 (4): Requires the department to establish guidelines describing how the department and commission will determine whether water quality standards in waters affected by non-point sources are being met.
- ORS 468B.035: Authorizes the department to implement the Clean Water Act.
- ORS 468B.160 (3): Requires the department to conduct statewide programs to identify and characterize groundwater quality.
- ORS 468B.162 (4): Requires the department submit a report to the legislature on January 1 of each odd numbered year on the status of groundwater in Oregon.
- ORS 468B.190: Requires the department conduct a groundwater monitoring and assessment program based on vulnerability to contamination that determines status, long term trends and emerging problems.

The Department also implements the requirements of the Clean Water Act. Clean Water Act requirements related to monitoring include:

- Section 106 (d): “ Administrator shall not make any grants under this section to any state which has not provided or is not carrying out as a part of the program-(1) The establishment and operation of appropriate devices, methods, systems, and procedures necessary to monitor, and to compile and analyze data on (including classification according to eutrophic condition) the quality of navigable water and to the extent practicable, groundwaters including biological monitoring; and provisions for annually updating such data and including it in the report required under Section 305 of this Act.”
- Section 303(d) (1) (A) & (B): Requires each state to identify waters within its boundaries for which effluent limits and controls of thermal discharges required by section 301 are not stringent enough to meet water quality standards and to assure protection and propagation of a balanced indigenous population of shellfish, fish, and wildlife.
- Section 305 (b)(1): Requires each state submit a biennial report by April 1 on even numbered years that includes a description of the water quality of all navigable waters in the state, an analysis of the extent to which they provide for shellfish, fish, wildlife and recreation, the extent to which the elimination of pollutants has provided for the above and recommendations for additional actions necessary to do so, the economic and social costs to do so, and a description of the extent of non-point source pollutants and recommended actions to address non-point sources including costs.
- Section 314: Requires the establishment of a clean lakes program including an assessment of the status and trends in water quality in publicly owned lakes and list of impaired lakes and the pollutant sources in those lakes.
- Section 406: Requires the establishment of a coastal recreation water monitoring and notification program.

Agency Specific Monitoring and Information Needs

Water quality data are needed by virtually all of DEQ's water programs. Every two years, new statewide water quality data are compiled and evaluated for compliance with Oregon's water quality standards. Water quality data are needed to identify emerging water quality problems and to identify where new water quality standards may need to be developed. Waters not meeting water quality standards requires additional, more detailed water quality data to investigate and quantify pollution sources for allocating pollution reduction responsibilities and developing projects and plans to achieve compliance with water quality standards over time.

Water quality data is also needed to understand the condition of Oregon groundwater. Groundwater provides critical services including drinking water, agriculture and in-stream flows. Monitoring data is used to identify emerging contamination problems, to develop plans in areas with known contamination issues and to track progress in areas with established groundwater management plans.

High level water quality information, such as indices and metrics, are also needed to communicate with decision makers and the general public on the status and changes in water quality across Oregon. Complex water quality data may be too detailed and time consuming for non-scientists to interpret for making important decisions. Surrogate measures that simplify the data without compromising the accuracy of the information are needed to assist with interpreting complex information. Moreover, DEQ's water programs use additional environmental data, including physical and climate variables.

DEQ needs water related monitoring data and information to:

- develop and renew water quality permits.
- develop the 303 (d) listing of impaired waters of the state. (April 1, even years)
- report on water quality issues statewide 305(b) report. (April 1, even years)
- develop Total Maximum Daily Load models. (ongoing)
- understand compliance with water quality regulations.
- develop of new water quality standards.
- calculate the Oregon Water Quality Index (annual Key Performance Measure).
- assess groundwater conditions in groundwater management areas.
- assess groundwater conditions statewide.
- understand and reduce pesticides in targeted watersheds by using monitoring data and adaptive management.
- understand current use pesticides, legacy contaminants, industrial intermediates, and pharmaceuticals and personal care products in watersheds statewide for the development of reduction strategies.
- inform recreation contact risks associated with bacteria on the coast.
- inform recreational contact risks associated with cyanotoxins.

Status and Implementation of Agency Monitoring Strategy

DEQ has implemented many of the monitoring programs and activities outlined in “A Strategy for Monitoring Oregon’s Waters 2005”. Resource limitations, competing priorities and emerging water quality issues have shifted some of the focus envisioned in the strategy. Below is a summary of monitoring activities currently being implemented by DEQ and how they compare with the goals envisioned in 2005.

Probabilistic Monitoring of Rivers and Streams

Proposed: Rotating basin approach, based on a probabilistic assessment of streams and rivers. DEQ will sample 50 random sites within three, 3rd-field HUCs per year (150 sites/year).

Actual: Participation in the National Rivers and Streams Assessment:

Approximately 50 sites every five years

An addition 25-50 sites per year in one to two watersheds.

Large River Network

Proposed: A fixed station network of approximately 150 sites located on more than 50 rivers across the state currently makes up the large river monitoring network. These sites cover 4th order and larger rivers; there is one site for approximately every 56 miles of 4th order and larger river in the state.

Actual: DEQ currently monitors 131 large river fixed station sites statewide. In addition, DEQ receives funding from the Oregon Department of Agriculture to monitor an additional 19 sites on agricultural lands using the same protocols.

Reference Site Monitoring

Proposed: Reference sites within each of the fifteen, 6-digit Hydrologic Unit Codes (HUCs) will be sampled as part of the rotating basin probabilistic surveys.

Actual: DEQ reinitiated reference site monitoring using a new screening tool for selecting reference site locations. Currently 12 statewide reference trending sites are monitored annually.

TMDL Monitoring Total Maximum Daily Load

Proposed: Involves intensive monitoring at targeted sites at a 4th field HUC scale. The data is used in the development of maximum daily loads for specific pollutant parameter(s) in waterbodies identified in Oregon’s list of impaired waters (303d). Monitoring needs are determined along with resource requirements, priorities are established, and resources are allocated based on those priorities.

Actual: We currently operate at about half of the TMDL monitoring effort proposed in DEQ’s 2005 strategy.

Mixing Zones

Proposed: Increase the number of mixing zone studies completed per year from approximately 15 to 25 or 30.

Actual: DEQ does not receive funding to conduct mixing zones but currently conducts up to five per year for communities that have limited resources. This effort changes annually.

Toxics Monitoring

Proposed: The objectives of toxics monitoring in Oregon are to provide data to understand the risks to human health and aquatic life posed by current use and legacy contaminants in water, sediment and fish tissue. Broadly the strategy is to:

- Gather information to characterize the presence and concentration of current-use pesticides, legacy pesticides, combustions byproducts, metals and industrial intermediates in Oregon's rivers, streams, lakes and estuaries.
- Use this information to identify sources of these chemicals.
- Present and make available information gathered for public benefit.
- Work with DEQ internal groups, community groups and Oregon citizens to identify opportunities for reducing these pollutants.

Actual: An initial statewide round of samples was collected using a risk-based, targeted sampling design. Initial toxics monitoring resources enabled 3 sampling events in 2 geographic areas per year at approximately 20 locations with a sub-set that included sediment and fish tissue. Reduced resources have reduced coverage to 2 sampling events in one geographic area.

Groundwater Monitoring

Proposed:

- Reinstate risk based targeted groundwater monitoring statewide.
- Continue monitoring in the three Groundwater Management Areas.
- Implement a long-term trending network in the three GMAs.

Actual: Statewide groundwater monitoring resources were provided to reinstate groundwater monitoring efforts on a statewide basis. Trend monitoring in the groundwater management areas continues. However, no long term monitoring network has been established statewide, and reductions in capacity for monitoring groundwater resources have scaled back monitoring efforts by one third at both the statewide scale and in the groundwater management areas.

Beach Monitoring

Proposed: The beach monitoring program is a cooperative effort between the Oregon Health Authority (OHA) and the DEQ that utilizes the specific authorities and capacities of each agency to accomplish the work. During summer months, the DEQ provides bacteria data to OHA to assess health risks to beach users and post advisories if bacteria levels exceed action values.

Actual: Beach monitoring is operating as projected in the strategy.

Lakes Monitoring

Proposed: Proposed work includes a targeted lake monitoring design within a rotating basin approach. The objective is to quantify water quality conditions in lakes with known or suspected water quality problems and document whether water quality criteria are violated. In addition, evaluate satellite imagery to characterize and track seasonal trends in chlorophyll, phyocyanins and turbidity and collect sediment cores to characterize long-term trends in lake conditions based on diatom assemblages.

Actual: DEQ participates in the National Lake Assessment every 5 years. In 2017, DEQ supplemented funding from the EPA to get a statistically valid sample for Oregon and incorporated toxics monitoring.

Estuary Monitoring

Proposed: Continue to participate in the EPA National Coastal Condition Assessment.

Actual: DEQ continues to participate in the National Coastal Condition Assessment every 5 years. Additional work on sediment and tissue toxics are done in estuaries when the toxics monitoring program rotates to the Oregon coast.

Environmental Data and Information Gaps

DEQ's water programs are working on improved environmental data acquisition, storage and retrieval capabilities to access the DEQ laboratory's data and other documented environmental data collection sources. Ready access to environmental data sets will provide more complete information for addressing high priority water program needs such as: the development of water quality standards, permit development, environmental assessments, compliance with regulations, watershed planning (TMDL's), and evaluating project effectiveness. Development of standardized, consistent metrics for evaluating and measuring environmental outcomes will help allocate limited resources. Access to more environmental data will reveal where the information gaps still exist and what environmental data is needed to fill them.

Oregon needs ongoing data collection to identify and control new toxic chemicals that may threaten important beneficial uses in surface water and groundwater. Finally, long term water quality data sets for understanding trends and effectiveness environmental projects and programs is limited.

Oregon Department of Fish and Wildlife

Geographic and Jurisdictional Responsibilities

The mission of the Oregon Department of Fish and Wildlife (ODFW) is to protect and enhance Oregon's fish and wildlife; and their habitats for use and enjoyment by present and future generations. With respect to the beneficial uses of water, ODFW is responsible for the management of aquatic life, including fish. Oregon has 73 known native freshwater fish species, as well as a number of subspecies, distributed across Oregon's diverse aquatic ecosystems.

ODFW's management of native fish species is guided by the [Native Fish Conservation Policy](#) (NFCP), which identifies three management goals:

- Prevent the serious depletion of native fish;
- Maintain and restore naturally produced fish in order to provide substantial ecological, economic and cultural benefits to the citizens of Oregon; and
- Foster and sustain opportunities for fisheries consistent with the conservation of naturally produced fish and the responsible use of hatcheries.

The NFCP is implemented through [conservation and recovery plans](#), which identify the desired and existing status of native fish, key limiting factors, management options to address limiting factors, and the monitoring required for evaluation of success.

ODFW does not have direct regulatory authority over water quality or quantity, but the agency provides comments and guidance to other state and federal regulatory agencies regarding water use, instream flow rights, water quality standards, hydroelectric application review, land use/development proposals, and instream and riparian habitat restoration and protection.

Agency Specific Monitoring and Information Needs

With respect to fish and fisheries, ODFW requires information to address several overarching needs, including:

- Determining if there is a conservation concern for native fish species;
- Identifying limiting factors affecting Species Management Unit (SMU)[1] persistence;
- Determining the extent of non-native species;
- Categorizing habitat for protection and restoration guidance, consistent with ODFW's [Fish and Wildlife Habitat Mitigation Policy](#); and
- Informing decisions and evaluating outcomes of management actions (e.g., harvest, hatcheries, habitat restoration).

Specific monitoring needs are identified in conservation and recovery plans. In addition to the fish management needs outlined above, ODFW utilizes water quality and quantity data to inform comments and guidance to other state and federal regulatory agencies regarding water use, instream flow rights, water quality standards, hydroelectric application review, and land-use/development proposals.

3. Legal Authorities Related to Water

- The Oregon Fish and Wildlife Commission is charged with the protection and propagation of fish in the state. This includes responsibility for regulating harvest of fish, protection of fish, enhancement of fish populations through habitat improvement, and the rearing and release of fish into public waters (See ORS 506.036). ODFW's Fish Division is responsible for the management of all fish and other marine life over which the State Fish and Wildlife Commission has regulatory jurisdiction (ORS 506.142).
- As the state agency with fish and wildlife expertise, ODFW is directed to provide comments to Water Resources Department regarding water use applications, permit extensions, or transfers of use (See OAR 690-033; OAR 690-315; and OAR 690- 380 for transfers). ODFW also has the authority to file for instream water rights (ORS 537.336).
- Vector Control - Vector Control Districts and Counties must obtain ODFW approval before applying pesticides to control vectors (ORS 452.140 and ORS 452.245). ODFW's role in vector control is to review and approve the use of pesticides used by Vector Control Districts or Counties in order to protect fish, wildlife and their habitats.
- Fish Passage – Fish passage is required in all waters of the state in which native migratory fish are currently or were historically present.
 - ODFW is responsible for determining the current or historical presence of native migratory fish and for reviewing and approving passage plans, waivers, or exemptions from providing passage. Regulations covering fish passage can be found ORS 509.580-910 and in OAR 635, Division 412.
 - The owner or operator of artificial obstructions located in these waters must address fish passage requirements prior to abandonment or specific trigger events (e.g., installation, major replacement, a fundamental change in permit status).
- Scientific Take Permits – OAR 635-007-0900 requires a Scientific Taking Permit issued by ODFW in order to take fish from the waters of the state for scientific or educational purposes. Statutory Authority is found in ORS 506.119 (See also OAR 635-007-0910 through 635-007-0950).
- A few more to add here (e.g., in-water blasting permits, fish screening and bypass requirements, fish and wildlife habitat mitigation guidance)

Status and Implementation of Agency Monitoring Strategy

ODFW currently implements several large-scale research, monitoring, and evaluation (RME) programs to track things like habitat status and trend, population health, and management action effectiveness, generally as called for in conservation and recovery plans or other management frameworks. The summaries below provide a description of these larger-scale RME programs, but they are not a comprehensive listing of ODFW's monitoring activities.

[West Region Fish Research \(Corvallis Research Laboratory, CRL\):](#)

CRL houses fish RME projects from ODFW's West Region and Conservation and Recovery Program. Several of these projects are linked through the use of a common site selection and rotating panel design to allow for better integration of data and analyses. Projects based at CRL include:

- *Oregon Adult Salmonid Inventory and Sampling Project (OASIS)*. The OASIS project is responsible for conducting spawner surveys for coastal and lower Columbia River anadromous salmon and steelhead populations, and spring Chinook salmon in the Willamette basin.
- *Salmonid Life Cycle Monitoring Project (LCM)*. The LCM project monitors adult spawners and out-migrating juvenile salmonid abundance and provides marine and freshwater survival estimates for Coho salmon at a network of life cycle monitoring sites in western Oregon.
- *Aquatic Inventories Project (AQI)*. The AQI project monitors the status and trend of stream habitat within the distribution of Coho salmon on the Oregon Coast and in the lower Columbia River basin. In 2014, AQI incorporated surveys for juvenile salmonids on the Oregon Coast and tributaries to the lower Columbia River (Western Oregon Rearing Project, [WORP](#)).
- *Coastal Chinook Research and Monitoring Project (CCRMP)*. CCRMP provides information to support Oregon's participation in the Pacific Salmon Treaty (PST).^[1] CCRMP conducts research and monitoring to determine spawner abundance of coastal Chinook salmon and to estimate harvest of Oregon's coastal Chinook salmon in ocean and freshwater fisheries.
- *Willamette Salmonid Research, Monitoring and Evaluation (Willamette RME)*. The Willamette RME program provides information about the salmon, steelhead, and bull trout populations in the Willamette River Basin. Specific work includes (1) monitoring of hatchery and naturally-produced spring Chinook and steelhead returning to hatcheries, fish monitoring facilities, and spawning grounds; (2) assessments of reintroduction programs for spring Chinook above U.S. Army Corps of Engineers (USACE) dams; (3) evaluation of hatchery release strategies; (4) assessment of impacts by hatchery summer steelhead; (5) monitoring of juvenile salmonids migrating into USACE reservoirs; (6) ecological and behavioral studies of salmonids rearing in USACE reservoirs, (7) genetic assessments of Willamette basin salmon and steelhead populations; and (8) research and monitoring of bull trout in the upper Willamette Basin.
- *Native Fish Investigations (NFI)*. NFI conducts statewide RME on Oregon's non-anadromous native fish to provide scientific information on the status, life history, genetics and habitat needs for Oregon's native fish populations. Current and past projects include studies of life history, genetics and limiting factors of bull trout in Northeast Oregon; status, age and growth, spawning ecology and habitat associations of Oregon chub in the Willamette Valley; distribution, abundance and habitat associations of Pacific and western brook lamprey on the Oregon Coast; movement and seasonal habitat use of westslope cutthroat trout in the John Day Basin; movement of juvenile redband trout in the Upper Klamath River; and design of monitoring strategies for several non-anadromous species.
- *Research, Evaluation, Data, and Decision support (REDD)*. The REDD group focuses on incorporating the latest scientific advances into sampling methodologies, statistical analyses, predictive modeling, and decision-making research to better measure and understand the trajectories of fish species.

East Region Fish Research (Northeast-Central Oregon Fish Research and Monitoring, NECORM):

NECORM is responsible for fish research and monitoring across a broad geographic area from Hood River in the lower Columbia River upstream to the Imnaha River in northeast Oregon. This program focuses on high priority monitoring identified in federal and state Conservation and Recovery Plans for Oregon steelhead and Chinook salmon populations in the Middle Columbia and Snake Rivers, Reasonable and Prudent Alternatives (RPAs) in the Federal Columbia River Power System Biological Opinion, the Lower Snake River Compensation Plan, and the NPCC Columbia Basin Fish and Wildlife Program. The program evaluates status of populations and habitat; tracks progress and efficacy of actions taken to improve status and reduce threats; redirects actions that are not producing desired outcomes, supports decisions regarding commercial, tribal and recreational fisheries; and provides knowledge to assess effectiveness of hatcheries for mitigation and recovery. Tribal and Federal managers as well as other private groups rely extensively on this program to provide information and guidance related to restoration and enhancement efforts, and many of these projects are conducted cooperatively with Tribal co-managers. Specific program objectives include assessing:

- abundance, productivity and life history of Fifteen Mile Creek steelhead;
- reproductive success of stray hatchery and wild steelhead and influence of hatchery strays on natural productivity in the Deschutes River basin;
- habitat, productivity and life cycle survival of John Day River summer steelhead and spring Chinook salmon;
- abundance, productivity, survival and outmigration of Umatilla River salmonids;
- Umatilla Hatchery effectiveness;
- productivity, life cycle survival, hatchery effectiveness, and habitat-steelhead production relationships of Grande Ronde Basin steelhead;
- life history, life cycle survival, supplementation, hatchery effectiveness, and habitat-production relationships for Grande Ronde and Imnaha Chinook salmon;
- hatchery supplementation, relative reproductive success, and hatchery effectiveness for Imnaha Basin summer steelhead; and
- status and trends of wild, natural, and hatchery stocks of anadromous salmonids to the Hood River Subbasin.

Data and Information Gaps

Each of ODFW's fish RME programs was designed to operate at a specific scale, and many were designed and implemented in response to listings under the federal Endangered Species Act. These RME programs have facilitated a better understanding of salmonid population fluctuations and distribution of populations and their habitat, but resources have not supported sustained monitoring for many non-anadromous species. Monitoring data provided to-date has been crucial to informing harvest and progress towards recovery, as well as generally improving our understanding of occupancy, population dynamics and habitat distribution for a subset of fish species. However, retrospective monitoring (e.g., status and trend monitoring) may not provide a strong basis for guiding management strategies where the past may not be a good predictor of the future (e.g., climate change). Given emerging pressures on natural resources, prospective monitoring is essential.

To inform natural resources management decisions under these emerging conditions, a broad suite of species need to be monitored, but sustainable long-term funding for monitoring is scarce. To these ends, ODFW's REDD group is developing an integrated monitoring framework that will provide more comprehensive coverage of species, is economically viable, and can adapt and incorporate best available science in statistical and modeling techniques, genetics, remote sensing, decision support tools, and ecosystem theory.

[1] The PST is an international agreement between the U.S. and Canada to conserve Pacific salmon and manage salmon harvest

[1] A Species Management Unit (SMU) is a collection of populations from a common geographic region that share similar genetic and ecological characteristics.

Oregon Department of Forestry

Geographic and Jurisdictional Responsibilities

The Oregon Department of Forestry (ODF), through administration of the Oregon Forest Practices Act (FPA) and rules, oversees and coordinates on measures designed to maintain and improve water bodies (streams, lakes, wetlands) in Oregon that are in non-federal, non-tribal forestland. Ownerships of these lands include private industrial, private non-industrial, state, county, and non-profit, except where cities or counties have adopted ordinances that meet standards described in statute. These measures are BMPs principally designed to meet water quality standards set by the Oregon Department of Environmental Quality (DEQ), or to enhance fish habitat (addressed in coordination with the Oregon Department of Fish and Wildlife and the Oregon Watershed Enhancement Board). ODF also coordinates inquiries related to pesticides with the Pesticide Analytical and Response Center (PARC).

Agency Specific Monitoring, Data, and Information Needs

In 2016, the Department of Forestry updated their Monitoring Strategy. This Strategy focuses on implementation and effectiveness monitoring of rules and voluntary measures on forestland that is both non-federal and non-tribal. The agency addresses monitoring through a regular process to audit implementation of rules, and through studies to test effectiveness. The Strategy articulates the following high-priority questions related to water:

Implementation

What are compliance rates for rules for riparian areas in forest operations?

What are compliance rates of riparian buffer requirements designed to prevent or minimize stream sedimentation and/or meet water quality standards and TMDL load allocations in Type F streams? (According to the Oregon Forest Practices technical rules, type F streams are those that are used by fish. Type D streams are those that have domestic use, but are not fish-bearing. All others are classified as type N streams).

What are the compliance rates with BMP requirements for roads, skid trails, and high risk sites?

What fraction of culverts in forest operation areas currently meet FPA standards? For the fraction that does not meet standards, what are the causes (e.g., legacy, recent storms, insufficient FPA compliance)?

Are pesticide rules being followed?

Effectiveness

When implemented, how effective are (new) riparian prescriptions (voluntary or regulatory) at protecting water quality, providing large wood recruitment and attaining desired future conditions?

What fraction of riparian areas in forest operation areas are currently on track to meet FPA riparian "desired future condition (DFC)" targets? For the fraction that is not on this track, what are the causes (e.g., due to legacy, blow-down, lack of hardwood-to-conifer conversion, insufficient FPA compliance)? Do DFC targets translate into mature forest conditions that meet water quality standards and other goals?

Are forest practice rules effectively protecting headwater (small Type N) streams such that local and downstream beneficial uses are protected? Key issues include effects on stream temperature, large wood recruitment, stream flow, sediment delivery, mass wasting initiation and debris torrent processes, macroinvertebrates, and how those effects are translated downstream.

Are forest practices, including roads, under current rules effective in meeting all applicable water quality criteria established by DEQ, including those established by TMDLs, for water quality parameters affected by forest practices on fish and non-fish bearing water bodies?

Are culvert replacement projects effective in restoring conditions beneficial to fish? What factors such as upstream habitat length and conditions, channel gradient, culvert design, etc. correlate with effectiveness?

Status and Implementation of Agency Monitoring Strategy

ODF updated its monitoring strategy in 2016. The department's monitoring focuses on assessing the effectiveness of its rules, and the implementation of both the rules and voluntary measures (primarily, those forestry-related ones from the Oregon Plan for Salmon and Watersheds). As of 2017, to implement the Strategy, the Oregon Board of Forestry has directed the department to scope a study on assessing effectiveness of riparian protections in eastern and southwestern Oregon. Additionally, we are designing the final analyses of the Riparian Function and Stream Temperature (RipStream) study. These analyses will assess the effectiveness of riparian rules along small and medium fish-bearing streams to recruit large wood and produce the desired future conditions for these riparian stands. We are in conversation with OWEB and other state agencies to design studies to assess the effectiveness of forestry-related voluntary measures from the Oregon Plan for Salmon and Watersheds.

The Agency has the following monitoring and analysis projects in progress:

- Completing the final analyses for the Riparian Function and Stream Temperature project:
 - Large wood recruitment
 - Desired future conditions of riparian management areas,
- Assessing implementation of forestry-related voluntary measures under the Oregon Plan for Salmon and Watersheds,
- Determining which riparian effectiveness monitoring question(s) to address in eastern and southwestern Oregon, a summary of the level of information already available, and initial scoping of methods to address the question(s), and
- Continuing the annual compliance audit of forest practices rules.

The Department also participates in the Watersheds Research Cooperative that uses paired studies to test various forest practices.

Data and Information Gaps

The data and information required are specific to each monitoring study the Department conducts. The most important gaps in information are those related to the aforementioned high priority monitoring questions. The gaps are clarified in the process of designing each study.

Oregon Water Resources Department

Geographic and Programmatic Responsibilities

By law, all surface and groundwater in Oregon belongs to the public. The Water Resources Department is the state agency charged with administration of the laws governing surface and groundwater resources. The Department's core functions are to protect existing water rights, facilitate voluntary streamflow restoration, increase the understanding of the demands on the state's water resources, provide accurate and accessible water resource data, and facilitate water supply solutions.

In 1909, the State Engineer's Office, the Department's predecessor, officially began registering water use. The Office worked in close partnership with the U.S. Geological Survey (USGS) to monitor water resources. The Department continues to work closely with the USGS on both surface water and groundwater monitoring and related studies. Together, the Department and USGS operate a gage network around the state of more than 500 stream gages. Of the over 250 gages operated by the Department, nearly 90% are close to real-time.

The Groundwater Act of 1955 (ORS 537.505 to 537.795 and ORS 537.992) establishes the authority for groundwater management and monitoring statewide to ensure the preservation of the public welfare, safety, and health. The Groundwater Act also directs the state to determine the extent, capacity, quality, and other characteristics of its groundwater bodies (ORS 537.525 (6)), 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.

ORS 537.099 requires all governmental entities to monitor monthly water use and report water data annually to the Water Resources Department. This requirement has been in place since 1987. The rules governing the state's Water Use Reporting Program are found in OAR 690-085. Since the Water Resources Department holds instream water rights in trust, the agency is responsible for monitoring instream water rights per OAR 690-085-0010(2)(d).

Agency Specific Monitoring and Information Needs

Oregon's first Integrated Water Resources Strategy (IWRS) was adopted by the Water Resources Commission in 2012 and describes numerous coming pressures that may affect our water needs and supplies. The IWRS places an emphasis on data and monitoring to support decision-making, with a primary objective to better understand surface and groundwater resources today, and to better understand the interaction or connection between these resources. The IWRS emphasizes expanding the state's monitoring networks and fostering inter-agency data collection and processing. The IWRS led to the development of the Department's first Monitoring Strategy, which was finalized in February 2016. This strategy outlines key surface water and groundwater monitoring priorities for the following:

Climate Change

- Identify basins susceptible to changing flow regimes (e.g., basins that receive a significant percentage of precipitation as snow) and establish gages to quantify the rate of change in the magnitude, frequency, duration, and timing of streamflow.
- Identify groundwater systems with areas of recharge within the rain-snow transition zone and monitor groundwater level responses to climatic impacts.
- Work with the USGS 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., USGS Hydro-Climatic Data Network stations, Geospatial Attributes of Gages for Evaluating Streamflow stations).

Extreme Events

Floods

- Identify gages that measure natural peak flows contained within channel and can be measured. Increase the number of high-flow measurements or relocate these gages.
- Upgrade gages in flood-prone areas to transmit data in real-time for flood forecasting and early warning systems. Work with other state agencies and municipalities to identify at-risk areas.
- Identify watersheds within the Rapid Assessment Flooding Tool (RAFT) program that would benefit from additional gages and/or additional measurements.
- Deploy temporary gages for real-time monitoring of high flow events.

Drought

- Establish streamflow gages in locations that are vulnerable to low-flow conditions, to help with water supply forecasting.
- Establish water-level gages or inflow and outflow gages on reservoirs that provide water supplies or instream releases and that are also susceptible to short-term drought.
- Identify gages currently used for low-flow distribution and drought statistics; upgrade to near real-time, as needed.

Wildfire Conditions

- Place traditional streamflow gages or rapid deployment gages in recently burned watersheds to track and send alerts regarding potential flash flooding and debris flows.

Groundwater Protection

Identify Groundwater Level Trends

- Construct dedicated observation wells in key aquifers around Oregon to expand and improve long-term groundwater level data collection; locate wells in areas of high groundwater demand, hydraulic connection between aquifers and streams, and groundwater recharge locations.
- Install data logging equipment in key observation wells to expand the continuous groundwater level data collection network.
- Estimate annual aquifer recharge rates for basins in Oregon, and compare aquifer recharge to aquifer discharge (via pumping wells, or discharge to streams and springs).

Understand Surface Water / Groundwater Interactions

- Pair stream gages with observation wells in areas of stream-aquifer interactions.
- Target key basins for dedicated observation well installations to be monitored in conjunction with stream gages.
- Rank streams in Oregon based on the percent of annual yield contributed by groundwater. This ranking would provide a way to structure and prioritize long-term monitoring activities.

Aquifer Storage, Recovery and Recharge

- Construct dedicated observation wells in key basalt aquifers around Oregon to expand and improve long-term groundwater level data collection. Target wells in areas of potential aquifer storage and recovery (ASR) and artificial recharge (AR) projects with nearby surface water supplies.
- Expand continuous groundwater level data collection in key observation wells.
- Work with local water users to conduct ASR and AR feasibility studies for specific projects and water needs.

Water Management

Improve Distribution and Regulation Effectiveness

- Place gages in locations that will help distribute water and validate regulation calls quickly. In particular, select reaches where regulation takes place frequently. Optimal sites may include areas near large water withdrawals or at specific locations named in water rights.

Predicting the Response of the Hydrologic System to Diversion or Appropriation

- Establish observation wells and stream gages in areas where groundwater basin studies will take place.
- Establish observation wells where the volume of requests for groundwater permits is high, and the number of recent groundwater-level measurements is low.

Water Availability

- Establish natural flow stream gages in areas likely to see an increase in water development in the near future to adequately capture before and after conditions.
- Establish gages above diversions and impoundments in major streams (i.e., measure natural streamflow) throughout the state.
- Establish evapotranspiration measurements to improve water availability consumptive use estimates.
- Improve the resolution of the water availability model by establishing gages in regions of the state where stream gage density needs to be increased.

Water Use Data

- Coordinate the Water Use Reporting and Significant Points of Diversion programs.
- Establish quality assurance procedures to verify the accuracy of water use data.
- Monitor and report surface water diversions in high priority watersheds.
- Establish a water use reporting requirement for irrigation wells in declining or critical groundwater areas.

- Integrate the Water Use Reporting program with quasi-real-time water management.
- Utilize satellite-based remote sensing imagery to estimate consumptive use on irrigated lands.
- Collect groundwater use data from observation wells that are actively pumped.

Dam Safety

- Place gages to appropriately serve as early warning systems for high flow events that could indicate dam failures. Prioritize high hazard dams that have been evaluated as unsafe.

Instream Needs

Characterizing Instream Needs

- Identify basins with sensitive, threatened, and endangered species (e.g., coastal tributaries) and install monitoring equipment to help characterize the suite of flows through these basins.
- Collaborate with other state agencies and watershed councils to monitor streamflow in order to support restoration and conservation activities.

Protecting a Suite of Instream Needs

- Increase the number of stream gages with telemetry (real-time monitoring) in reaches with instream water rights.
- Increase the number of gages in streams where water has been transferred to instream water rights.
- Ensure there is a stream gage located at the mouth of each state scenic waterway.

Water Supply

Meeting Future Water Demands

- Establish stream gages and monitoring wells in watersheds with projected increased demand in locations that allow for tracking of the entire water distribution network.
- Employ the Department's Water Use Reporting Program to track demand over time.
- Use telemetry in wells to monitor actual groundwater use in each basin.

Forecasting Seasonal Water Supply

- Ensure communities in every basin have access to natural streamflow data from long-term, high-elevation gages, mid-level snow survey sites, and baseline groundwater levels.
- Participate with federal partners in the Jet Propulsion Laboratory's "Airborne Snow Observatory" (ASO) Program. ASO is a LiDAR-based system used to quantify snowpack conditions which will provide complete, accurate real-time water supply data for water management.

Partnering with Other Agencies

- Develop instream flow prescriptions
- Monitor water quality (e.g. temperature)
- Restore and conserve instream habitat

Status and Implementation of Agency Monitoring Strategy

The Department has begun conducting evaluations of the 250 stream gages it operates to determine whether or not monitoring sites are individually and collectively providing the data needed to support the monitoring priorities identified in the 2016 Monitoring Strategy. For each monitoring site, the evaluations will determine the value of the information being collected at a particular location. In addition, the evaluations will determine the effectiveness of the network as a whole and identify areas for improvement. The monitoring strategy also has a section on how to evaluate the monitoring network, which identifies five next steps and describes them in more detail:

1. Update and add new attributes for each monitoring site in a centralized database
2. Identify and rectify problematic sites
3. Solicit input from external partners on future monitoring locations
4. Evaluate current and potential monitoring sites
5. Determine gaps in monitoring data based on network evaluations

Data and Information Gaps

At this point, OWRD has not identified key data gaps. The results from the stream gage network evaluation will help determine where there are gaps in the data and where the Department should place new monitoring sites. The Department is also actively soliciting input from external partners on future monitoring locations.

Once the network evaluations and scientific studies for each monitoring priority are completed, the Department can determine where any data gaps and redundancies exist. These results will show where high value monitoring sites exist and where certain sites may need to be decommissioned.

Oregon Department of State Lands

Geographic and Programmatic Responsibilities

The Oregon Department of State Lands (DSL) administers Oregon's removal-fill law by requiring people who plan to remove or fill material in wetlands or waterways to obtain a permit. In addition, DSL is responsible for wetland conservation oversight which includes maintaining the State Wetland Inventory; providing wetland planning assistance; developing standards and tools for identifying and assessing wetlands and streams; and reviewing and approving wetland delineations for planning and regulatory permitting. DSL manages approximately 780,000 acres of land and state-owned waterways, primarily to generate money for K-12 schools through the Common School Fund.

Agency Specific Monitoring and Information Needs

Oregon's Wetland Program Plan (WPP) is designed to focus wetland protection and restoration work in a strategic way, and communicate long- and short-term objectives to the Environmental Protection Agency and others. The plan is intended to help partner organizations stay informed and connected to wetland planning. The 2017-2021 WPP core elements of work include objectives and actions in the categories of monitoring and assessment, regulatory, voluntary wetland restoration and protection, and water quality standards for wetlands.

DSL's monitoring needs focus on:

1. Providing decision makers with the best possible information on the extent, type, and health of our state's wetlands and the ecosystem services they provide.
2. Tracking and evaluating regulatory program activities and environmental results in achieving avoidance and minimization of wetland losses, preservation of wetland functions, and replacement of unavoidable or unauthorized losses with sustainable wetlands of at least equal size and functionality.
3. Tracking progress in maintaining, improving, and increasing healthy wetland ecosystems through protection and restoration.
4. Integrating water quality monitoring and assessment into the State's wetland monitoring strategy.

Status and Implementation of Agency Monitoring Strategy

DSL develops the tools necessary to assess the functions and values provided by wetlands and streams in Oregon for purposes of the regulatory program. The Oregon Rapid Wetland Assessment Protocol (ORWAP) version 3.1 was published as an update in November 2016 and the Stream Function Assessment Tool (SFAM) is scheduled for beta release by the end of 2017. DSL, US Army Corps of Engineers and US Environmental Protection Agency are developing policy changes to the regulatory program to improve environmental results of compensatory mitigation. These improvements target a more functions-based, watershed-scale approach to compensatory mitigation utilizing information from the tools mentioned above. State rulemaking will begin in early 2018 with rules anticipated to be effective in early 2019.

As part of the mitigation program improvement project, DSL will work with our partners to develop a coordinated monitoring strategy to be poised to evaluate program success and adaptively manage the program. This work will begin January 2018 and includes development of a protocol to describe the survey design and methodology, selection of measures to inform performance standards, field site assessment methods and procedures, and documenting the data analysis and data compilation process needed to evaluate performance at a program level.

DSL wetland mapping efforts helps to make information about wetlands more accessible and complete. Beginning in fall 2017, DSL will restructure and update Oregon's Statewide Wetland Inventory (SWI), which will integrate mapped wetlands in Oregon from the National Wetland Inventory, local wetland inventories and compensatory mitigation sites. The SWI and additional information about wetlands and streams in Oregon will be hosted on an interagency mitigation portal on the Oregon Explorer website. DSL will also host the SWI on a new map for local land use planners on our website.

In addition to compensatory mitigation site monitoring required for permit authorizations, DSL periodically evaluates status and trend for Oregon's wetlands. DSL will update the Willamette Valley Wetland Change Study beginning in 2019. The South Slough National Estuarine Research Reserve (SSNERR) will complete baseline habitat mapping on Reserve lands (coastal ecological features including land cover and land use) and an update of maps showing the distribution of eelgrass in the Coos estuary using data collected in 2016. SSNERR implements various monitoring activities on the Reserve managed wetlands. Under the 2017-2021 Wetland Program Plan, SSNERR staff will begin projects to characterize sedimentation and accretion rates in Coos estuary tidal wetlands, characterize the density and spatial distribution of tidal wetlands at the Reserve's Sentinel Site stations, and map the presence and extent of invasive species impacting Reserve managed wetlands.

Data and Information Gaps

Rapid assessment methods like ORWAP and SFAM either (1) associate the functions (i.e. water quantity and quality, habitat, species diversity) provided by a wetland or stream with its observable features or (2) summarize data from similar wetlands and streams and provide these results to the user. Functionality is determined as higher, moderate or low for 14 specific functions of wetlands and 11 specific functions in streams. Additional studies are needed to more directly associate features and data to functionality of similar types of wetlands and streams.

Successful aquatic resource management also requires information on a watershed scale. This includes information about watershed health, limiting factors and functions, and priorities for improvement. This information is used by DSL and stakeholders to identify needs for avoidance and minimization of impacts. It is also important to identify and prioritize the types and locations of compensatory mitigation projects that will benefit the watershed; and DSL will work closely with natural resource agency partners to develop a coordinated monitoring strategy to evaluate mitigation program success. This will include developing measures, monitoring standards, methods, and protocols and will ideally integrate well with other aquatic monitoring efforts.

Oregon Watershed Enhancement Board

Geographic and Jurisdictional Responsibilities

In 2001, the Oregon Legislature “institutionalized” the Oregon Plan for Salmon and Watersheds (https://www.oregonlegislature.gov/bills_laws/ors/ors541.html) or the “Oregon Plan”. This legislation placed state authorities in statute, including those directing OWEB to develop and implement a statewide monitoring program in coordination with Oregon Plan agencies and partners.

Throughout its development, the Oregon Plan historically emphasized the importance of monitoring the status of environmental factors that affect watersheds and habitat quality as well as monitoring salmon population status and trends. Support for monitoring and reporting represents the State’s commitment to evaluate the benefit of measures implemented to improve watershed conditions and salmon populations and to make changes in policies or programs when necessary. With Executive Order 99-01, the Governor expanded the original monitoring program developed for the 1997 Coastal Salmon Restoration Initiative (CSRI) to include all watersheds and salmon species and to the habitats of native fishes throughout the state.

In 2010, Oregonians passed Ballot Measure 76, providing long-term support for OWEB to administer grants to local partners to implement the Oregon Plan for Salmon and Watersheds, the Oregon Conservation Strategy, and Oregon’s native fish and wildlife conservation and recovery plans. The subsequent statutory changes specifically called out native species and their habitats, along with water quality as components of the priorities for OWEB investments.

OWEB programs support Oregon’s efforts to restore native species and their habitats, improve water quality, and strengthen ecosystems that are critical to healthy watersheds and sustainable communities. OWEB carries out three interrelated monitoring functions:

- strategic guidance for cooperative monitoring,
- tracking of accountability and effectiveness of restoration investments, and
- reporting on the progress of the Oregon Plan.

OWEB does not have any legal authorities related to water. Chapter 541 of the Oregon Revised Statutes describes OWEB’s role in Watershed Management and Enhancement as part of the Oregon Plan: https://www.oregonlegislature.gov/bills_laws/ors/ors541.html.

Agency Specific Monitoring and Information Needs

[The Oregon Plan Monitoring Strategy](#) (OPMS) was written in 2003 and provides a framework to evaluate existing monitoring efforts and to expand efforts to assess the effectiveness of Oregon Plan and OWEB activities. This Monitoring Strategy is comprehensive and identifies information needs that several State agencies have a role in collecting.

Monitoring needs outlined in the strategy focus primarily on topics such as:

1. The need to evaluate the effectiveness of restoration efforts by monitoring representative samples of specific project, activity, and program types.

2. The need to provide sufficient guidance so that OWEB investments in monitoring contribute to Oregon's overall monitoring priorities.
3. The need for a monitoring network to help evaluate progress toward environmental benchmarks, watershed restoration, and native species recovery goals.

Status and Implementation of Agency Monitoring Strategy

OWEB has worked with the appropriate state agencies to implement the OPMS. In addition, the Monitoring Group within OWEB's Technical Services Program has taken specific steps to fill information needs in Section 2 of this report. OWEB has commissioned studies to evaluate the effectiveness of restoration efforts of specific restoration actions at a programmatic level that spans broad spatial and temporal scales. Some of the restoration actions that have been evaluated to date include livestock exclusion, riparian planting, juniper removal, fish barrier removal, irrigation efficiency, wetland restoration, and dam removal. The Conservation Reserve Enhancement Program (CREP) effectiveness monitoring was completed during the 2015-17 biennium.

In addition, OWEB funds local, state, federal and tribal water monitoring activities through its grant programs, contributing to the implementation of the OPMS. Grantees also can request funding for effectiveness monitoring (EM) of restoration projects that are funded by OWEB to determine if an individual restoration project is effective at meeting its biological and ecological objectives. EM is not a requirement of any OWEB grant, and is above and beyond compliance monitoring/implementation reporting. Information from project-level EM can be helpful in assisting the restoration practitioner and OWEB in determining the biotic and abiotic changes on the treatment area from the restoration action(s) and informing future restoration design.

Currently OWEB has administrative procedures in place to track short-term outputs associated with restoration projects, including via reporting tools such as the Oregon Watershed Restoration Inventory. OWEB now is working with its partners to evaluate the ecological outcomes associated with funding for specific actions in a particular geographic area. In particular, the approach employed by OWEB's Focused Investment Partnership (FIP) investments provides an opportunity to learn about the progress and outcomes possible under longer term (i.e., 6 year), larger scale investments. Information emerging from these investments will be used by the OWEB board, staff, and stakeholders to adaptively manage partnership investments in the future.

OWEB currently is updating the agency's Strategic Plan. This update is anticipated to be completed in mid-2018, and the updated plan will have a 5-10 year time horizon. The board has identified "coordinated monitoring and shared learning to advance watershed restoration effectiveness" as a strategic priority for impact in the plan. To support this priority, OWEB will look for ways to develop capacity throughout Oregon's system of watershed stakeholders to monitoring progress, learn and adaptively manage, track effectiveness, and use data to advance watershed restoration.

Data and Implementation Gaps

The OPMS outlines examples of data and information needed to address the gaps in the State's monitoring approach, as of 2003. There may be value to revisiting these gaps to determine which have been addressed, which still exist, and what new data and/or information gaps have

emerged in the intervening years. However, such an effort would need to involve all relevant agencies that are engaged in the Oregon Plan.

The following list provides a summary of data and information needs from OWEB's perspective:

Tracking water and species monitoring efforts:

- Understand what parameters are being monitored regularly, and where these efforts are happening throughout Oregon. Mapping locations provides information about the scope and context of water and species monitoring efforts.
- Tracking results at specific locations over time helps evaluate cumulative progress.

Linking investments to conservation outcomes:

- Access to high-quality datasets to inform and develop ecological indicators to evaluate trends related to aquatic habitats and watershed condition
- Define conservation outcomes resulting from restoration, management practices, and Oregon Plan policies over the short and long term.
- Methods to use monitoring results to identify the highest priority areas for restoration that will offer the best return on investment.

Oregon State University - the Institute for Natural Resources and the Institute for Water and Watersheds

Geographic and Jurisdictional Responsibilities

The Institute for Natural Resources (INR) and the Institute for Water and Watersheds (IWW) are legislatively established institutes created to provide information and assistance to decision-makers in Oregon, particularly to address natural resources and water issues. INR and IWW are partner programs that share staff and work together, based on differing mandates and authorities, although both are mandated to work statewide, and have chosen to work elsewhere across the west and throughout the world to address critical natural resource issues.

Agency Specific Monitoring and Information Needs

Neither INR, IWW nor OSU have any specific monitoring and information needs aside from those identified in the Oregon Natural Areas Act (ORS 273.561-.591), related to evaluating the status of Oregon species and ecosystems, and their distribution within designated natural areas. The primary mission is to support agencies and decision-makers, and help solve agency problems and information gaps.

Status and Implementation of Agency Monitoring Strategy

Neither INR nor IWW have an agency monitoring strategy.

Data and Information Gaps

INR and IWW share and distribute information through a partnership with the Oregon State University Libraries, creating the Oregon Explorer, a natural resources digital library. INR and IWW have identified some data gaps related to addressing key issues and programs identified in the most recent strategic plan. These include:

1. The lack of a number of statewide framework datasets needed to model and address key water issues, including:
 - a. elevation – at least a 5 meter DEM statewide,
 - b. hydrography (statewide hydrography created from the 1 or 5 meter DEM),
 - c. updated and agreed-upon 12-digit HUC boundaries created from the new elevation dataset, and
 - d. a mid-scale (1:24,000) surficial geology and at least a few key soil attributes for the state, although statewide SSURGO remains the goal.
2. Software to share observations and records of fish and aquatic invertebrates and statewide 12-digit HUC distributions of all fish and key freshwater invertebrates.

Overlapping Themes, Needs and Summary

Overlapping Themes

Effectiveness

Information to understand the “**effectiveness**” of activities in protecting water related resources is a cross cutting theme among Oregon’s natural resource agencies. This information need is characterized differently by each agency reflecting the unique responsibilities, priorities, and resources available for understanding how water is influenced by activities that fall within the scope of their mission.

Based on these unique responsibilities, “effectiveness” may be interpreted as:

1. Characterizing progress on implementing activities designed to protect streamside areas;
2. Evaluating compliance with streamside buffer regulations;
3. Evaluating the effectiveness of riparian rules to protect water quality and aquatic habitats;
4. Understanding the cost/benefit of projects focused on watershed restoration priorities;
5. Measuring progress towards attaining instream water quality standards;
6. Measuring progress towards restoring salmon habitat and populations;
7. Understanding the benefit of activities designed to restore stream flows; or
8. Collecting information on the effectiveness of protection, restoration and mitigation of wetlands.

Providing information on “effectiveness”, regardless of how it is defined, requires a well thought out monitoring plan that can be implemented and updated as needed. The impacts of management activities conducted today may have immediate effects or take many years or longer to measure. The use of the appropriate indicators, measured at the right scale and frequency over time, will provide the information needed to answer important questions about the trajectory of our water resources.

Status and Trends

Agencies also identified a number of important needs for statewide status and trends data. In particular, meaningful status and trends information for groundwater, seasonal water use, temperature, sedimentation, toxics, and harmful algal blooms were identified. There are many opportunities for our natural resource agencies to work together to provide the type of effectiveness and status and trends information needed through careful planning, collaboration and sharing of environmental data, and providing assistance to other state agencies when possible.

Needs Assessment

Natural resources agencies need better tools to share and understand water-related data. Resources for collecting data are often limited, emphasizing the need to maximize the utility of available information. Aging, outdated data systems make accessing and sharing difficult, time consuming and inefficient. As these data systems are replaced by the individual agencies to

meet their key data management needs, there is an opportunity to create efficiencies by having a list of the previously identified information needs of each of the water state agencies to see if any of these could be easily addressed within alternative systems. The STREAM Team provides a forum for discussing the business needs of individual agencies related to water associated data management and to recommend improvements for sharing this information.

More efficient, effective, and adaptive natural resource planning, investment, and monitoring across state agencies and resource conservation initiatives will require that Oregon's natural resource agencies:

- Understand what we have and what we will have (e.g., mapping of current and predicted states of natural resources at 1:24K);
- Understand and predict demands on natural resources (e.g., document/map current and future resource use at 1:24K scale); and
- Use this information to develop tools to prioritize/categorize areas for utilization, regulation, restoration and/or protection.

In this context, statewide stream temperature and flow monitoring is a key information need and a gap in monitoring coordination. Currently, OWRD has a statewide program for stream flow monitoring which includes approximately 260 gages operated OWRD staff and another 250 operated by USGS. Currently, 42% of OWRD gages are currently collecting temperature data and this percentage is continuing to increase with the installation of new probes. It is anticipated that many of the USGS gages also have temperature probes. The US Forest Service and the BLM have a number of probes selected areas on lands they manage, while ODFW, NOAA, OSU and many watershed councils each support temperature probes. A statewide stream temperature and flow monitoring program that would (1) inventory existing information from all entities, (2) identify gaps, (3) establish new monitoring sites, and (4) develop a common storage solution for continuous data would facilitate mapping of current and future resource states through stream network monitoring tools. Temperature and flow are of cross-cutting importance to many of the natural resource agencies, presenting a tangible opportunity for coordination and efficiency gains.

Members of the STREAM Team and those working on implementing this integrated water monitoring strategy have identified an initial eight recommendations to improve the ability of water monitoring agencies to work together:

1. Build upon existing inter-agency monitoring approaches, including those from the Oregon Plan for Salmon and Watersheds.

Monitoring teams developed under the Oregon Plan, the Agricultural Water Quality Pesticide Management Plan, and other efforts are valuable for fostering communication and data sharing among agency partners. Agencies and decision-makers should continue building upon existing efforts such as these. Collaborative efforts, such as the STREAM team, offer an ongoing forum to identify questions of mutual interest among agency natural resources specialists, and to develop solutions to common problems.

2. Support agency efforts around sharing results, and assist other agencies with data collection so that managers can allocate resources more efficiently, reducing costs and potential duplication of efforts.

While this recommendation is well documented, it is difficult to implement because there are no incentives for individual agency leaders to support the work of other agencies. The Governor's Natural Resources Office and / or the legislature could consider ways to create incentives to promote efficiencies.

3. Provide information about metrics, variables, and data management practices so that agency results can be easily shared and understood by tribal, state and federal agencies, along with key partners.

Support monitoring leaders and scientists within agencies to identify variables of interest to multiple agency partners (e.g. temperature, stream flow, presence of important fish species), along with identifying a permanent interagency funding source for ongoing efforts such as the monitoring calendar, map, and data sharing portals which can strengthen collaborative monitoring efforts.

4. Assure monitoring is undertaken at the appropriate scale.

The scale of inference for the sampling design needs to correspond to the scale of the question to be addressed (e.g. site, stream, watershed, or ecoregion). As such, identifying a set of standard scales for monitoring has the potential to lead to efficiencies in data collection and integration of different agency monitoring efforts.

5. Support web-based data tools.

Promote web-based tools that provide and interpret information about Oregon's waters. Web-based tools facilitate sharing of data, reduce duplication and create efficiencies, ensure consistent data entry by multiple partners, maintain data integrity, and enhance public participation.

6. Promote ecosystem services and markets.

Ecosystem services and the markets that can follow have the potential to expand the restoration and conservation water and aquatic habitats in the state. For these to be successful, more information needs to be available to allow for those working in these markets to be able to measure improvements and to track credit generation. These markets can both promote conservation and restoration and lead to better understanding of aquatic systems.

7. Develop regional monitoring strategies for the eight monitoring strategy basins (Figure 3), and continue to use regional "summits" to link local and regional groups to statewide and national efforts.

The STREAM Team have supported regional summits to bring together those collecting information on aquatic life and water within particular regions. This includes state, federal, and tribal agency staff, along with those from watershed councils, universities, municipalities and NGOs working with rivers, streams, lakes, estuaries and groundwater in these regions. In 2013, the STREAM Team convened a regional Summit in the John Day, Umatilla, and Grande Ronde basins and a summit was recently completed for the North and Mid Coast regions in February 2018. We are continuing with this successful approach to identify opportunities for coordination and to help local partners see how their efforts contribute to statewide results. Looking ahead, STREAM Team hopes to convene summits in other regions where needed and where time and funding permit until all of the regional strategies are completed.

Regional summits allow groups to connect with others collecting data, and create efficiencies by making connections and identifying methods that have been successful locally. They also can provide the basis for agreement on overall regional monitoring goals and priorities, and identify the funded and ongoing projects that a regional strategy could build upon. Figure 3 shows an idea for how to organize a set of regional strategies, based on combining some adjacent Oregon Plan Reporting Basins.



Figure 3. Map of 8 potential Monitoring Strategy Basins. The light blue lines are boundaries of OWEB's Reporting Basins.

8. Use results of monitoring to prioritize areas for further study, regulation, conservation, and restoration.

Adaptive management is a goal of all of the agencies working to protect Oregon's water resources, aquatic species and ecosystems. While it is included in all agencies' monitoring strategies, it can be difficult to implement, and many efficiencies can be gained through a coordinated approach.

Summary

State laws require agencies with responsibility for managing aquatic resources to be able to assure their efforts to restore, protect and manage sustainable uses are effective. To succeed at this effort, agencies must be able to understand the status and trends of these resources, which requires efficient monitoring. Successful aquatic monitoring to inform public policy decisions requires the ability to efficiently collect and store data, and to assure it is available for agency analysis and reporting. Data sharing is especially important when agencies are collecting similar data and when agencies are making decisions that could be enhanced by information collected by or available from another agency.

There is work underway at DEQ, DAS, WRD, PSU, along with the BLM, USFS, and USGS to address these issues, although not with a schedule that holds promise to meet the short-term needs identified by this strategy. The inter-agency STREAM Team provides a forum to discuss common issues and develop solutions together. STREAM Team is endeavoring to make progress by communicating to other agencies when and where aquatic monitoring is happening in Oregon through a shared calendar, and a monitoring map. Both the calendar and map will help agency natural resources specialists identify economies of scale and opportunities for collaboration.

In addition, efforts to better address water issues in Oregon led by the Governor's Office and the Oregon Watershed Enhancement Board also hold promise in promoting information sharing, creating efficiencies, and bringing partners together to address issues that currently stand in the way of needed improvements. Much work remains, but improving our capacity to understand the status and trends of our water, aquatic species and the habitats that support them will significantly improve our efforts to assure they remain sustainable.