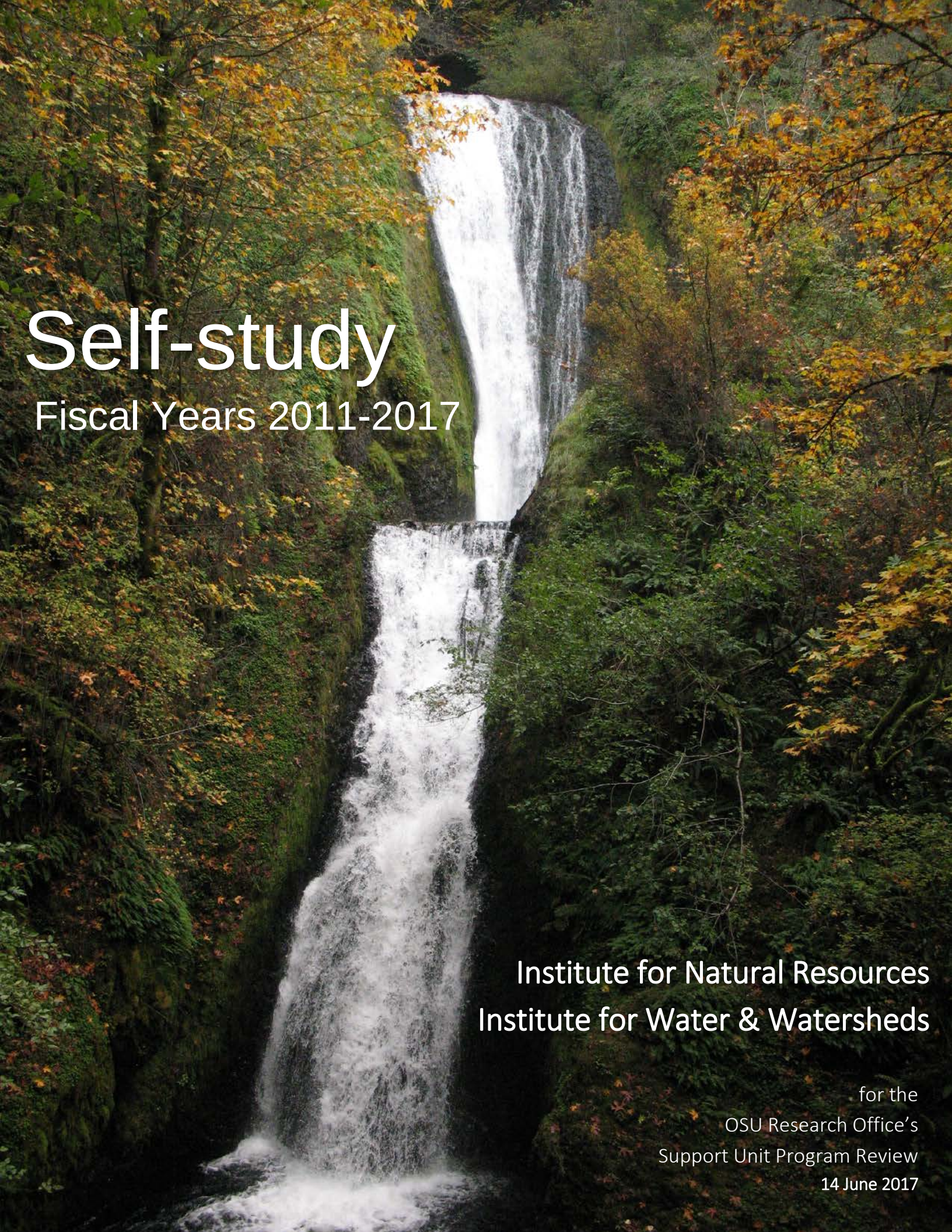

Self-study

Fiscal Years 2011-2017

Institute for Natural Resources

Institute for Water & Watersheds

for the

OSU Research Office's

Support Unit Program Review

14 June 2017

Self-study

Institute for Natural Resources
Institute for Water and Watersheds
Fiscal Years 2011-2017

14 June 2017

Prepared by

The Institute for Natural Resources

Oregon State University – Portland State University

The Institute for Water and Watersheds

Oregon State University

for

OSU Research Office's Support Unit Program Review (10-11 August 2017)

Created by the Oregon Legislature through the 2001 Oregon Sustainability Act, the Institute for Natural Resources' mission is to provide access to integrated knowledge and information to inform natural resource decision making and develop solutions in the context of sustainability. The Institute for Natural Resources is an Oregon public universities institute located at Oregon State University and Portland State University.

Created through the Water Resources Research Act of 1964 and a 2005 Provost Initiative, the Institute for Water and Watersheds' mission is to link OSU and other researchers within Oregon's public universities to water issues in Oregon.

For more information about this report please contact lisa.gaines@oregonstate.edu.

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Abbreviations and Acronyms

BLM	Bureau of Land Management
CWESt	Center for Water and Environmental Sustainability
DAS	Department of Administrative Services
DLCD	Department of Land Conservation and Development
DSL	Department of State Lands
EPA	U.S. Environmental Protection Agency
INR	Institute for Natural Resources
IWW	Institute for Water and Watersheds
NPS	National Park Service
ODF	Oregon Department of Forestry
ODFW	Oregon Department of Fish and Wildlife
OE	Oregon Explorer
ORBIC	Oregon Biodiversity Information Center
ORS	Oregon Revised Statute
OSU	Oregon State University
OWEB	Oregon Watershed Enhancement Board
OWWRI	Oregon Water Resources Research Institute
PSU	Portland State University
UO	University of Oregon
USFS	U.S. Forest Services
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

1.0 Background

Institute for Natural Resources

Mission. To provide access to integrated knowledge and information to inform natural resource decision making and develop solutions in the context of sustainability.

Legislative origin. The Institute for Natural Resources (INR) was established by the Oregon Legislature in July 2001 through the Sustainability Act. INR is a cooperative enterprise of Oregon's public universities tasked to link the scientific knowledge and expertise of universities and other research entities with natural resources decision making (ORS 352.808). As spelled out in the Oregon Revised Statute (ORS), the INR serves the following purposes:

a. Serve as a clearinghouse for scientifically based natural resources information.

b. Provide scientifically based natural resources information to the public in integrated and accessible formats.

c. Coordinate efforts with other state agencies and bodies to provide natural resources information to the public in a comprehensive manner.

d. Facilitate and conduct research.

e. Provide information and technical tools to assist decision making on natural resources issues.

f. Assist the State Parks and Recreation Commission in carrying out the Natural Areas Program by maintaining a data bank that contains a classification of natural heritage resources and an inventory of the locations of the resources. At a minimum, the institute shall record in the data bank the location of state natural areas, the natural heritage resources in those areas, sites that are inhabited by rare species, and lists that rank by rarity species, plant communities and ecosystem types. The institute shall make the information included in the data bank available to private landowners, researchers and local, state and federal agencies.

g. Assist the State Parks and Recreation Department in carrying out the Natural Areas Program by reviewing and providing recommendations on proposals for registration and dedication of natural areas.

INR was established as an institute within Oregon State University through a 2001 Category 1 proposal (see Appendix A for comparison of the legislation and the OSU Category 1 charter).

Institute for Water and Watersheds

Mission. To link OSU and other researchers within Oregon's public universities to water issues in Oregon and to leverage OSU's existing excellence in water and watersheds to meet emerging water challenges in Oregon and throughout the world.

Legislative origin. The federal Water Resources Research Act of 1964 created a network of water resource research institutes at land grant universities across the U.S. The water centers were designed to be university-wide to assure participation of all disciplines available in water research. The Institute for

Water and Watersheds (IWW), then known as the Oregon Water Resources Research Institute (OWRRI), was one of the 54 water institutes located at land grant universities across the nation that received a small federal grant to provide base support for water resources research needs in each state.

Our role with Oregon's public universities

INR is headquartered at OSU, with offices in Corvallis and Portland. INR was always envisioned as an Oregon public universities institute (formerly the Oregon University System). It was only in 2011 that a legislation amendment allowed us to be physically located beyond OSU. Since that time we have maintained offices at both OSU and Portland State University (PSU). Vice Presidents of Research and/or other representatives at OSU, PSU, and the University of Oregon (UO) have served on the INR advisory board since its inception.

OSU has a rich history in water research. To build on this strength, OSU established IWW in 2005 through a Provost Initiative that sought to increase OSU's capacity and facilities dedicated to water and watershed research.

INR and IWW have shared an advisory board since late 2014. In addition to the Vice Presidents of Research from OSU, PSU, and the UO, representatives of federal agencies, the Governor's Office, and the nongovernmental and private sectors also serve on the board. Many of our collaborations and partnerships with faculty and units within these universities tend to be project-based (see Collaboration and Partnership section); however, we do have long-standing relationships with: *OSU* – OSU Extension, OSU Libraries and Press, the Water Resources Graduate Program, and the Natural Resources Leadership Academy; *PSU* – the College of Liberal Arts and Sciences, the Institute for Sustainable Solutions, the Department of Biology, the Center for Lakes and Reservoirs, and Oregon Solutions; and at *UO* – the School of Law. See Appendix B for more information about our role within Oregon's public universities and how it applies to OSU and PSU's missions of instruction, research, and public service.

Re-merger of INR and IWW

In 2014, then Vice President of Research Rick Spinrad, and Associate Vice President Rich Holdren suggested that INR and IWW take cautious steps to re-merge based on discussions we had regarding the challenges of a formal merger at that time. Those challenges were: (1) INR's name being in statute, requiring legislative action for a name change; (2) OSU water faculty wanting "water" to be part of a named institute at OSU; (3) a formal merger possibly requiring following the process to establish a new institute within OSU; and (4) organizational codes follow grants and all existing grants would have to end before an organization code can be removed from the OSU system. This idea of a re-merger, however, has its history in OSU's Center for Water and Environmental Sustainability (CWESt).

In the late 1990s the duties and programming of Oregon's water research center that was established by the Water Resources Research Act of 1964 was moved within the newly formed CWESt. CWESt housed several long-term programs and projects – the OWRRI, funded through the U.S. Geological Survey (USGS); Technical Outreach Services for Communities and Technical Assistance for Brownfields, funded through the U.S. Environmental Protection Agency (EPA), and the Sustainable University program, supported by the OSU Research Office. In July 2005, with an infusion of a $1.5m Provost Initiative to increase OSU's capacity and facilities dedicated to water and watershed research that went beyond the current support

for CWESt's water focus, CWESt was renamed the Institute for Water and Watersheds and its other efforts were redistributed to other organizations on campus (see Appendix C for INR and IWW history).

Since 2003, INR and IWW (then CWESt) have shared office space, faculty research assistants, administrative staff, and graduate and undergraduate student workers and interns. INR and IWW serve similar integrative functions. Pairing IWW's water focus with INR's focus on information access, data and information management, and science synthesis in a wider range of natural resources issues expands INR and IWW's ability to address multi-agency and multi-disciplinary resource issues.

2.0 Key Goals and Objectives

Goals from the 2013-2017 strategic plan

The goals, objectives, and actions of the 2013-2017 strategic plan are based on a series of meetings and conversations with INR staff, the INR Board of Advisors, and stakeholders who have been engaged with INR over the years.

- Goal 1: Increase the ability of others to efficiently and effectively deliver environmental and resource outcomes.
- Goal 2: Extend the reach of knowledge and information to inform natural resource decision making.
- Goal 3: Enhance the relevance and delivery of our distinctive suite of services and products.
- Goal 4: Strengthen our capacity and effectiveness.

With the re-merger, IWW adopted INR's strategic plan. INR-IWW is in the very early stages of updating the current plan by creating a "2018+ INR-IWW Strategic Plan" (see Appendix D for a draft list of goals and strategies for the updating of the plan).

Services

INR-IWW services are applied and user-inspired across our focus areas. Services include:

- **Linking science to decision making.** Convening policy-relevant science dialogues; conducting applied research; carrying out science synthesis and systematic reviews; developing natural resources indicators and monitoring tools; and program evaluation.
- **Managing data and information.** Compiling and integrating natural resource datasets; developing tools to access natural resources maps and spatial datasets; monitoring data exchange formats and standards; creating collaborative workspaces online; and providing access to data and information.
- **Providing technical assistance and analysis.** Developing, adapting, and transferring science-based tools, models, and methods; and conducting scientific analyses to evaluate the status and trends of natural resources.
- **Coordinating research**. Managing interdisciplinary research projects; coordinating research teams; and, facilitating large grant proposal development.

- **Training and educational opportunities.** Project-based internships and student worker positions; sponsoring educational seminars; and training within the Collaboratory.

Focus areas

Our efforts focus on areas where university-agency interactions and engagement can help address issues, solve problems, and inform decisions. Our strength is to provide coordination and synthesis on topics that are multi-agency and multi-disciplinary. Some key areas where we work include:

- **Biodiversity and Conservation**. INR, from its inception, has had legislative mandates to manage Oregon's Natural Areas Program and Oregon's Biodiversity Program, which is accomplished at INR's Oregon Biodiversity Information Center (ORBIC). ORBIC is part of a national biodiversity partnership with NatureServe and other state programs across North America. Projects include maintaining Oregon's part of a national biodiversity information system (BIOTICs), Oregon's Invasive Species information system (iMapInvasives) in partnership with the Oregon Invasive Species Council, and management of the managed area information system. INR also works with state and federal partners on wetlands conservation and mitigation; plant and wildlife conservation and restoration programs; and on many conservation efforts that require interagency partnerships, such as Oregon's Sage Grouse and Snowy Plover conservation efforts.
- **Information Access and Science Synthesis.** In Oregon there are more than eight state and eleven federal agencies which collect natural resources information. Oregon also has 88 watershed councils, 45 soil and water conservation districts, 31 counties, 242 cities, 4 MPOs, and many universities that collect environmental data. None of these entities have a mandate to share information they collect. INR was established to, among other things, help integrate this broad array of data, and to provide scientifically based information to the public in order to improve natural resources decision making. Through a suite of programs and tools, including the Oregon Explorer (OE), we provide access to integrated data, information, and university-based research. We also facilitate access to natural resources information and data though convening policy dialogues, and conducting science reviews and syntheses.
- **Landscape Assessment and Mapping.** All new land management plans and most natural resource decisions require managers and planners to understand where the important resources are, and how decisions are going to affect them – both in their area of interest and across the broad landscape. INR helps decision makers by capturing characteristics of the vegetation, fish, and wildlife; and by building models that reflect how these change over time and space, based on different plans. These models allow planners to visualize current and future conditions for species, vegetation, and aquatic resources, as well as important natural resources, such as timber availability, fire risk, rangeland productivity, and riparian conditions.
- **Water.** Oregon's economic vitality is directly tied to water. Water is "virtually" embedded in all Oregon products, from timber and salmon to solar panels and semiconductors. But water supply and demand in the state is changing. In the academic community there is growing recognition that the solutions to future water challenges lie not within a single discipline or subject but through the connection of concepts between multiple academic fields and through successful collaboration between academics and water managers. IWW's Collaboratory is a shared

laboratory available to all researchers at Oregon State University. The Collaboratory provides access to low-to-no cost trace-level, freshwater analysis instrumentation and procedures, including trace-level (ppb) analysis of rainwater, surface water, stormwater, soil water and groundwater of comparable quality to commercial laboratories. In addition, the Collaboratory is a staffed teaching laboratory where undergraduate and graduate students can receive training, conduct analyses, and collaborate with other students.

Evaluation

Evaluation was written into our 2013-2017 Strategic Plan and states that, "a programmatic review will occur during the fifth year of the strategic plan (2017) and will help shape the 2018-2022 strategic planning process". The plan also states that INR would create an evaluation plan that includes developing instruments and methodology to determine both the degree and effectiveness of collaborations that achieve our primary goals. Though this was not done formally, we have been taking account of our work through annual performance evaluations of all of INR's staff, and highlighting the impacts of our work and products on our websites (http://inr.oregonstate.edu/products and http://water.oregonstate.edu/) and in our February 2016 *Year-in-Review 2015* by looking at our indicators (Table 1).

Table 1. Performance indicators from the 2013-2017 INR-IWW strategic plan

Quality	• *Timeliness:* INR's ability to provide support to clients and users within a timeframe consistent with the expectations of the groups engaging with the INR. • *Client and user satisfaction*: The extent to which clients and users are satisfied with INR's processes, services, products, and outcomes. • *Collaborations:* The usefulness of INR's processes for engaging partners, collaborators and other stakeholders, and incorporating input.
Outputs	• *Quantity of products*: The quantity of relevant, credible, and useful products. • *Use of products:* (1) The extent to which available INR products are believed by partners, collaborators and other stakeholders to be relevant, credible, and legitimate to natural resources planning, management, and/or policy; and (2) the degree to which INR products and services have the potential to influence desired outcomes and/or change behaviors by clients and users. • *Usability of products*: An assessment of the usability of INR processes, services, and products, including whether or not partnering with INR was worth the effort.
Outcomes/Impact	• *Information support:* Extent to which INR work assists in natural resource-related decision making. • *Decision quality:* The extent to which INR clients and users believe that the process leading to a decision and an expected outcome(s) of the decision were the best that could be made with available information.

3.0 Current Resources

Human resources

INR-IWW currently has 20+ full- and part-time staff members, plus 10 temporary field staff and student workers. Staff have PhDs, Master's, and/or Bachelor's degrees. Staff are specialists in science synthesis,

modeling, ecology, geographic information systems and remote sensing, outreach and engagement, project management, facilitation, and research with the INR-IWW focus areas.
Our staff are located in Corvallis, Portland, and Coos Bay. See Appendix E for our organizational chart.

Financial resources

Approximately 85% of INR-IWW's funding comes from grants and contracts (see Figure 1 for expenditures). INR receives some core support from the Oregon legislature (an average of $198,000 per year to OSU and $41,000 per year to PSU for work with Oregon Parks and Recreation Department (OPRD)) and from the OSU Research Office ($50,000 per year). IWW receives $50,000 per year from the OSU Research Office. The sources of grants and contract funding have varied over the years; however the majority of competitive and non-competitive grants and contracts awarded to INR-IWW come from state and federal agencies. Fewer awards come from local governments and non-governmental organizations. INR-IWW has sought and received targeted funding from foundations and other private sources for initiatives in key focus areas. Between FY11 and FY17 INR-IWW received $15.5 million in new grants and contracts (n=146), averaging slightly over $100,000 per grant. INR-IWW also has fee-for-services revenue. For our services related to data, ORBIC averages $50,000 per year, and the Collaboratory averages $11,500 per year. Figure 1 shows the grant expenditures for FY11 through FY17.

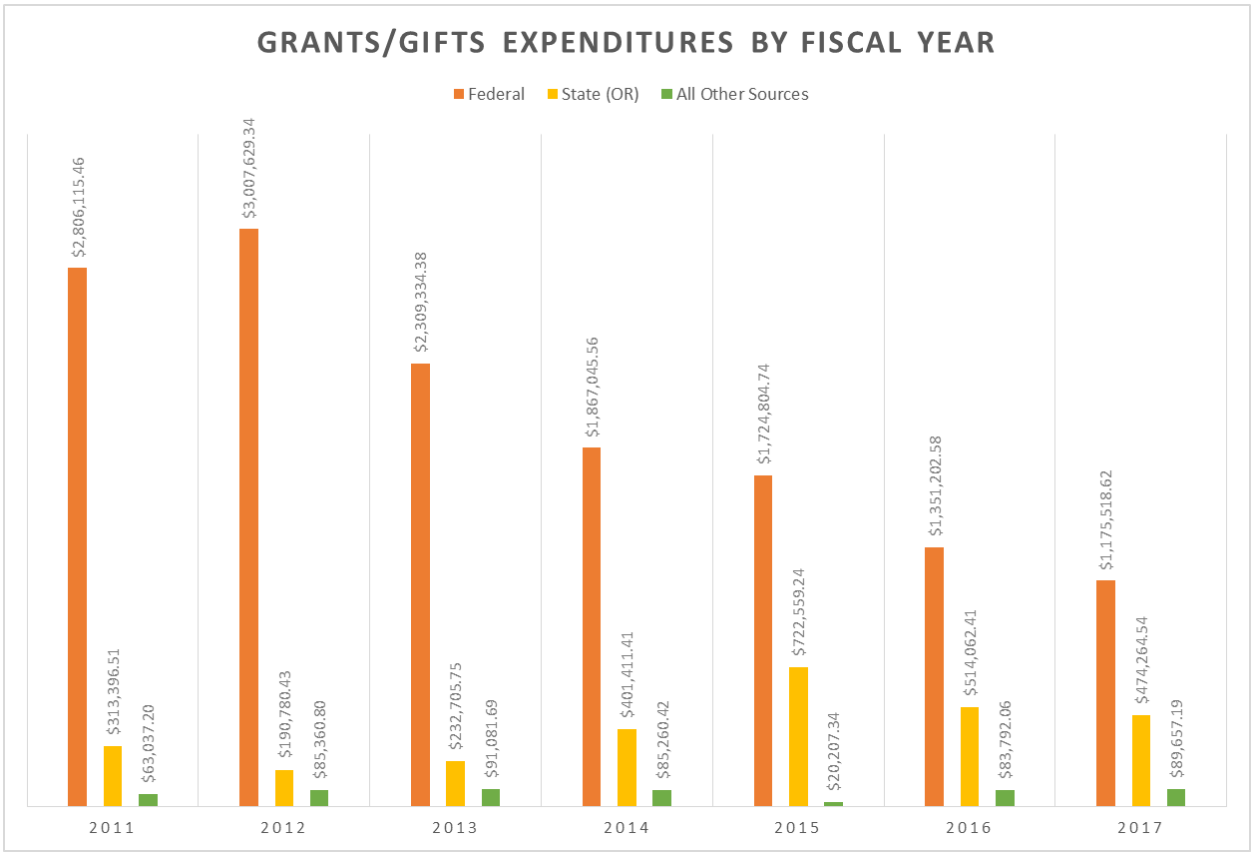


Figure 1. INR-IWW grant expenditures FY11 through FY17

4.0 Collaborations and Partnerships

INR collaborates with a variety of organizations, both through project-based connections, and through long-term partnerships.

Oregon public universities

INR-IWW has partnerships, collaborations, and working relationships with faculty, students, and units on within OSU, PSU, and UO. See Appendix B for more information about how our work ties into the universities' core missions of instruction, research and public service.

Oregon State University. OSU Extension, OSU Libraries and Press, the Water Resources Graduate Program, the Marine Resource Management Program, the Professional Science Master's Degree, the Environmental Sciences Program, the Natural Resources Leadership Academy, the Geographic Information Systems Certificate Program, the School of Public Policy, the College of Forestry, Oregon Sea Grant, the Department of Fish and Wildlife, among others.

Portland State University. Institute for Sustainable Solutions, Oregon Solutions, the National Policy Consensus Center, Center for Lakes and Reservoirs, Rae Selling Berry Seed Bank, the Department of Biology's PhD program and the herbarium, and the School of the Environment.

University of Oregon. School of Law, the Institute for a Sustainable Environment, the InfoGraphics Lab in the Department of Geography, and faculty within the Department of Landscape Architecture.

Activities we have engaged in over the last five years include, but are not limited to:

- **Departments and other Units**: having affiliated faculty appointments in academic multi-disciplinary programs (i.e., the Water Resources Graduate Program, Marine Resource Management, Environmental Sciences); serving on advisory boards (e.g., the OSU Sustainability Dual Degree Program; the OSU Environmental Health Sciences Center; UO Institute for Sustainable Environment); engaging in strategic planning processes (e.g., the OSU Marine Studies Initiative, the OSU Forestry Executive Council, the OSU Research Office, PSU School of the Environment), and serving on executive-level search committees (e.g., Dean of the College of Earth, Ocean, and Atmospheric Sciences; Oregon Sea Grant Director; and OSU Research Development Director).
- **Faculty:** managing large research projects to support multi-disciplinary research (e.g., Integrated Landscape Assessment Project, Willamette Water 2100); providing opportunities and programmatic support for faculty to serve as science advisors, on science expert panels, or conduct science reviews on topics of importance to the State (e.g., the West Coast Science Panel on Ocean Acidification; Senate Bill 202; Available Science Assessment projects); and providing opportunities for researchers to engage with state and federal agency executives to discuss the state-of-the-art of science as it applies to a particular topic (e.g., the Science Management Team).
- **Students:** serving as graduate advisors and on graduate committees; working with students and having them intern or be student workers; providing opportunities for students to conduct their

Master's level, non-thesis capstone projects or undergraduate honors thesis; and managing large-multidisciplinary projects where students conduct research for their Master's or PhDs.

Advisory board

The INR-IWW advisory board is comprised of members representing Oregon's public universities; federal, state and local government; private industry; and non-governmental organizations. The board is instrumental in helping to develop our mission and strategic plan, and in contributing to the identification of our key focus areas. For a full list of board members, please see http://inr.oregonstate.edu/about/advisory-board.

Other state, federal, and private collaborations/partnerships

Over the last five years, INR-IWW has been engaged in a number of multi-agency and multi-institutional efforts (Table 2).

Table 2. INR-IWW multi-agency and multi-institutional partnerships/collaborations

State – Governor's Natural Resources Cabinet – Oregon Geographic Information Council – Science Management Team – Integrated Water Resources Strategy – Climate Change Adaptation Framework – Department of Land Conservation and Development IMMI – STREAM TEAM – Sage Grouse Conservation Project (SageCon) – Oregon Coast and Marine Data Network (OCMDN) – Snowy Plover Monitoring and Recovery Project	**Federal and Regional** – Pacific Northwest Cooperative Ecosystems Study Unit – Colorado Plateau Cooperative Ecosystems Study Unit – 4-County Cooperative Weed Management Area – U.S. Geological Survey External Research – U.S. Geological Survey State Water Resources Research Institute Program – U.S. Army Corps of Engineers Institute for Water Resources – Western Landowners Alliance – Integrated Data Management Network – Western Invasives Network (WIN) – Willamette Aquatic Invasives Network (WAIN)
National – National Council for Science and the Environment – National Institutes for Water Resources – Consortium of Universities for the Advancement of Hydrologic Science (CUAHSI) – DataONE – USGS Protected Areas - US – National Park Service Vegetation Inventory – National Ecosystem Services Partnership – American Institute for Biological Sciences	**International** – Collaboration for Environmental Evidence – iMapInvasives Network – NatureServe Network – UNESCO-IHE – UNESCO-IHP – UNESCO Regional Office for Eastern Africa **Private** – Xerces Society for Invertebrate Conservation

We also have collaborations, partnerships, and/or project-based working relationships with:

– **State Agencies.** The Department of Administrative Services (DAS), the Oregon Department of Environmental Quality (DEQ), the Department of Land Conservation and Development (DLCD),

the Oregon Department of Forestry (ODF), the Department of State Lands (DSL), the Oregon Department of Fish and Wildlife (ODFW), the Oregon Watershed Enhancement Board (OWEB), and the California Department of Fish and Wildlife (CDFW).

- **Federal Agencies.** The U.S. Environmental Protection Agency (EPA), U.S. Forest Services (USFS), the U.S. Geological Survey (USGS), the Bureau of Land Management (BLM), the National Park Service (NPS), and the U.S. Fish and Wildlife Service (USFWS).
- **Tribal Communities.** Hoopa Valley Tribe, Confederated Tribes of the Umatilla Indian Reservation, and the Confederated Tribes of the Grand Ronde.
- **Public Universities outside of Oregon.** Humboldt State University, Duke University, North Carolina State University, and the University of California Davis, among others.
- **Non-governmental Organizations.** The Nature Conservancy, The Wetlands Conservancy, Defenders of Wildlife, and the Willamette Partnership.
- **Local Groups:** The City of Portland, Metro Regional Government, Lane Council of Governments, Rogue Valley Council of Governments, the Eugene Water and Electric Board, Clean Water Services, Benton County, Benton County, Umatilla County, Falls City, Alpine, La Pine, Oregon.
- **Private Entities.** Sierra Pacific Industries, Timber Products Company, Fruit Growers Supply Company, Earth20, the Rada Family (Mill City, Oregon), Wiley Family (Toledo, Oregon), and the Coale Family (Ukiah, California).

5.0 Recent Actions

Most of INR-IWW's actions are project-based. Table 3 highlights projects and project outcomes over the last 18 months. In addition to these efforts, INR-IWW staff have also worked to improve the dissemination of scholarly research by submitting articles for publication or providing peer review for journal articles and book chapters. For a list of projects since FY11, see Appendix F. In 2014, IWW was reviewed by USGS (Appendix G) and recently submitted its FY16 annual report to USGS (Appendix H).

Table 3. INR-IWW project-related actions (January 2016- June 2017)

Information Access and Science Synthesis	
Project or Product	**Outcome or Impacts**
Oregon Explorer new and enhanced products • Redesigned Oregon Spatial Data Library • Redesigned Communities Reporter Tool • Updated Planner's Map Viewer • Updated Measure 49 Analyzer • Redesigned Hazards Reporter • Updated Oregon Explorer Atlas	– Nearly 75,000 users in FY17 – Communities Reporter tool used by local planners to support community development and to track the economic, social, and environmental progress of Oregon. – Land use planning tools used by planners at county and city levels throughout Oregon. – Wildfire risk planning tools developing to support community wildfire protection planning. – Sage grouse tools developing to support habitat conservation and informed development.

• Updated Oregon Watershed Restoration Tool • Updated Oregon Watershed Enhancement Board (OWEB) Investment Tracking Tool • Creating the Biodiversity Map Viewer • Oregon Wildfire Risk Explorer	– Wetland tools used by public agencies, consultants, community members. – 12 OSU classes using the Oregon Explorer.
iMapInvasives	– Identification of new locations of high priority weeds invasive vertebrates (feral pigs, bullfrogs, etc.) and insects. – Helps managers prioritize survey and management efforts – Engages the public by communicating their observations to natural resource managers.
Biotics Rare Species Database	– Provided climate change vulnerability scores for dozens of Oregon plants, to be used in federal planning and prioritization projects. – Updated global and state ranks help direct survey and recovery efforts. – Informs private consultants which rare species are on or near their project areas. – Informs state and federal agency staff as to locations of state and federally listed and sensitive species for project planning.
SB202: Independent Science Review for Natural Resources	– Recommendations and process to conduct independent science reviews for natural resources for the state of Oregon for complex, multi-agency natural resource agencies led to the Interim Senate Committee for Natural Resources developing a bill, SB198, to put this into place.
Available Science Assessment Project	– Developed, tested, and evaluated a process for conducting available science assessment reviews for climate adaptation, in two test case areas –prescribed fire and sea-level rise. – *"This is, IMHO [in my humble opinion], one of the most important things to come out of a CSC [Climate Science Center] in a long time*." (Director, DOI National Climate Change and Wildlife Center, Reston, Virginia).
Ecological Effects of Tide Gate Improvement and Removal	– Review and synthesis of knowledge regarding the effectiveness of tide gate replacement and removal projects in benefiting salmonids and estuary conditions. Will help the Oregon Watershed Enhancement Board (OWEB) develop grants and evaluate applications, and ultimately helping guide decisions about which restoration projects to fund.
Washington State Legislature: Outcome Measures for Habitat and Land Acquisition and Environmental Regulations	– Helping the State of Washington identify best practices for their review of state and local land acquisitions and other efforts to conserve habitat and expand outdoor recreation. Using literature searches and subject matter experts to Identify current practices and more than 100 specific ecological and social outcome measures that are being used or proposed by similar programs in the U.S.
The Nature Conservancy – Nicholas Institute for Environmental Policy Solutions Bridge Project	– Conducted ecological and social analyses to bridge evidence-based impacts across environment, health and development communities.

U. S. Protected Areas Database – PAD-US with the USGS	– Partnering with the USGS, BSU and GreenInfo Network to complete the Oregon portion of the PAD-US, to help generate the *Completing America's Inventory of Public Parks and Protected Areas: An Action Plan for 2016-2020* report. – *"PAD-US is an incredibly informative and useful database – a powerful analyses and planning tool. As the best, seamless, authoritative national geospatial data framework for parks, public and private protected lands, PAD-US is the go-to source for a wide range of social, environmental, conservation and economic uses. We look forward to continued collaboration with USGS to develop applications for outdoor recreation, public access, community support and conservation."* – Bob Ratcliffe (National Park Service, Chief, Conservation and Outdoor Recreation.

Biodiversity and Conservation

Project or Product	Outcome or Impacts
Snowy Plover monitoring	– Documented population growth past recovery goals set by USFWS; birds are increasing in number and distribution. Plovers successfully nested at multiple sites along the north coast in 2017 after having been absent for over 30 years.
Rare, Threatened and Endangered Species of Oregon	– Reviewed and revised species ranks, assessed inclusion in ORBIC sensitive species lists. Impact: Published RTE book online; Used by the public and agency partners.
iNaturalist projects	– Collects invasive and rare species observations from casual and professional naturalists on the iNaturalist website. – Over 2000 observations provided by over 400 people living in or visiting Oregon. – Provides additional data for INR databases and mapping products, and communicates the importance of INR's work monitoring and mapping these species to iNaturalist users and the public.
Species ranking	– Reviewed ranks of common (S4/S5) vertebrates, information being used by ODFW in rule making process identifying which species can be held without a permit. – Updated status ranks for 189 at-risk (Survey and Manage) Fungi from western Washington, Oregon and northern California to assist the US Forest Service with their forest plan updates.
Section 6 Invertebrate Grants	– Coordinated grants totaling $140,310 in 2017 and $150,419 in 2016 for work on threatened, endangered and candidate invertebrate fauna in Oregon (roughly similar amounts funded in prior years).
Sage-Grouse Conservation Partnership (SageCon)	– Greater sage-grouse not warranted for listing under the Endangered Species Act. – Recognition of the SageCon partnership as a model of proactive and collaborative conservation. – Relationship building between INR and other partners involved in sagebrush steppe conservation and policy at all levels (federal, state and local).

	– Developed data, expert teams, and online tools to implement the Governor's Sage Grouse Action Plan.
Northern Sierra Fisher Translocation Project	– At the conclusion of the 2016 fall capture effort we documented 59 fishers occupying our northern Sierra Nevada reintroduction area, a nearly 50% increase since the last animals were reintroduced in 2011 from northwestern California. Currently developing monitoring recommendations for federal, state, and industry partners based on empirical data collected 2013-2016.
Stirling Fisher Reintroduction	– Developed cost-effective methods for monitoring carnivore populations.
Klamath Fisher Translocation Project	– Elucidated and submitted for peer-review a competitive interaction between fishers, gray fox, and ringtail that might have conservation implications across the mesocarnivore guild.
Hoopa Tribal Forestry Collaboration	– Fostering a broader relationship to increase Tribal capacity for project genesis, implementation, and product development, continuing work with fisher and extending collaboration to ringtails.
Northern Oregon Cascades Fisher Survey	– Surveyed and did not detect the presence of fisher in the northern Oregon Cascades, an incremental step in considering the feasibility of reintroducing fishers to formerly occupied habitat in Oregon.
Klamath Plateau BLM Fisher Study	– Building BLM capacity to manage for fisher by developing a more complete understanding of fisher habitat selection in the southern Oregon Cascades.

Landscape Assessments

Project or Product	Outcome or Impacts
Forest, Farms, and People: Land Use Change on Non-Federal Land in Oregon 1974-2014	– Created update to statewide maps showing patterns of development, and impacts to commercial, industrial and small private timberlands, as well as changes to agricultural lands. This work is assisting Oregon Department of Forestry, the Oregon Department of Agriculture, and the Department of Land Conservation and Development to measure their program success.
Integrated Landscape Assessment	– Outputs are critical to the US Forest Service for their assessment of alternative plans, both for large-scale projects, such as the Rio Grande National Forest Plan Revision in Colorado or the Joseph forest restoration project in Wallowa County, as well as for forest planning activities in Arizona, California, Oregon and Washington.
Assessing Riparian vegetation in the Willamette Basin	– Assisted Meyer Memorial Trust, OWEB and those working on restoration in the Willamette Valley assess success of restoration and protection efforts, by creating updateable maps of riparian vegetation structure.
BLM Assessment, Inventory and Monitoring	– Collects information on the status and trends of the BLM Rangelands in SE Oregon, with a focus on areas currently showing declines in greater sage grouse populations.
Washington Department of Natural Resources (DNR)	– Evaluated status and trend of DNR fire restoration and prevention activities to provide the Washington Legislature with information

	on how much restoration is needed, where and how quickly to significantly reduce wildfire damage and firefighting costs.
National Park Service Mapping	– Updated and improved the vegetation classification for the large National Parks in the Pacific Northwest. – Used the improved classification to develop detailed plant community maps as part of the NPS Inventory and Monitoring Program.
National Park Service National Natural Landmarks	– Evaluated and helped establish Lanphere Dunes as a National Natural Landmark in Northern California, recognizing 30 years of restoration.
Water	
Project or Product	**Outcome or Impacts**
Collaboratory	The Collaboratory is a shared laboratory that provides Oregon State University affiliates with access to low cost trace level, fresh water analysis instrumentation and procedures. – Total number of samples analyzed: 18,907 (FY16); 10,730 (FY17 through 3rd quarter). – Collaboratory users; 45 (FY16); 43 (FY17 through 3rd quarter). – Departments using the Collaboratory: 12 (FY16); 17 (FY17 through 3rd quarter).
Clean Water Partnership	Assisting state and federal agencies to work together to more efficiently gather water quality information and address major issues related to agricultural and forest impacts to rivers and streams, salmon restoration, groundwater impacts and water shortages. A focus for OWEB and the governor's office. 2017 outputs included a state monitoring calendar, map, strategy, as well as a cooperative partnership of agricultural interests, forest interests, and state and federal water agencies. – Created online map-based monitoring tool to show where monitoring data would be collected by different agencies and organizations in 2017.
Willamette Water 2100	INR-IWW is provided project support for this NSF project (multiple PIs: OSU, PSU, and UO). – Approximately 30 journal publications, 12 graduate theses, several Extension publications, an online synthesis report, and K-12 teaching materials. – The stakeholder engagement process and research methods of WW2100 helped inform the Willamette Basin Reservoir Review Study, a USACE and OWRD-led planning effort to reallocate stored water from Willamette Basin federal reservoirs.

Technology Transfer through USGS 104(b)	IWW is provided support by the USGS to support undergraduate research, as well as graduate student events: – Serious Gaming in Water Research: One thesis through Joint Programme in Water & Peace, and one publication with undergraduate as lead author. – Small Scale Aquifer Storage and Recovery: Poster presentation, publication, AWRA presentation by undergraduate student, and graduate student project underway in Alpine, Oregon. – Digital Water Atlas of Oregon: Undergraduate Honors thesis, linked to IWW webpage (oregonwater.info). – Sponsor of Hydrophiles (Water Students): Spring Water Symposium and Fall White Water Rafting Trip – Co-Sponsor: Water Resources Graduate Program Seminar series and OSU Hydrophiles/PSU Networking Event
Falls City, OR Groundwater Flooding	Groundwater flooding is an emerging problem globally with changes in land use (deforestation, impervious surfaces) and changes in precipitation patterns (more rain, less snow). Conflicts are intense. Falls City contacted IWW for process guidance and technical support. – One WRE graduate thesis with concurrent Certificate in Conflict Resolution. – IWW Director receives University Council on Water Resources (UCOWR) National Award for Public Service and Education.
Oregon team of the Urban Water Innovations Network (UWIN)	– Scope of project: An INR-IWW staff member is providing research support for this project which is part of an NSF research collaboration network (PIs: Haggerty (OSU), Hulse (UO), and Santelmann (OSU)). The Oregon UWIN project is developing a tool for modeling future conditions of urban water systems, and will regionally pilot the use of urban water sustainability indicators to compare water management approaches. The project is working with regional stakeholders from the Willamette Valley to identify realistic assumptions for futures scenarios and to identify regionally-relevant water management approaches.
Darlingtonia Botanical Wayside, Oregon State Park – co-PI with Water Resources Graduate Program	– State Parks concerned about impacts to endangered plant. IWW providing groundwater technical support and mentoring one graduate student on water quantity, water quality, sea level rise, and land use impacts.
Oregon Water Institute	– The Willamette Falls area near Oregon City undergoing repurposing and redevelopment. IWW worked with UO Architecture and PSU Vice President of Research in developing a multi-institution water research theme park. Presented proposal to White House Summit.

6.0 Assessment

Strengths

Focus on applied and user-inspired work. We seek ways of collaborating with partners that provide mutual benefits, and we are committed to creating products that are truly useful. The best way to create useful products is to involve users throughout project development and implementation, and to develop strong

partnerships and a supportive user base. Our project-related outreach focuses on improving awareness, trust and accurate understanding of project goals; increasing collaboration and communication efforts with potential partners; promoting the use of project products and feedback from end-users; and disseminating information about the project. We engage with partners, collaborators, and stakeholders through face-to-face meetings and workshops, conference calls, webinars, conferences, specialized presentations, and work with project sponsors to create outreach strategies that target customary and new stakeholders.

IWW welcomed the first Student Intern funded through the Reston USGS-Student Internship Program in 2016. IWW also uses the USGS WRRI funds to integrate undergraduates into their operations pursuant to a national drive requested by the USGS. Four undergraduate students have been retained to work on the Digital Water Atlas of Oregon, Small Scale Aquifer Storage and Recovery, Serious Gaming in Water, and the Oak Creek Urban-Rural Landscape – Hydrology Nexus. Three of the undergraduate students are enrolled in the University Honors College and use their research experience for Honors theses.

Breadth and depth of expertise at INR. INR-IWW staff have great skills that cross a wide range of topics and technical areas, as well as staff who can bridge the technical, managerial, and applied nature of our work.

University affiliation. INR-IWW's presence within OSU and PSU is essential to its perceived and actual neutrality and credibility, and access to a broad range of academic expertise and resources. INR provides a unique civic space for public agencies, NGOs and business to join with academics to address critical issues.

Responsiveness. INR is known for its responsiveness to agency and academic administrative needs. INR can develop work plans and carry them out much more rapidly than traditional academic units, enabling it to meet non-academic timelines.

Reputational. Agencies (state and federal) come back to us based on the reputation of our work. We are viewed as a neutral party for our core services and focus areas.

Relationships with agencies. We continue to have strong advocates within the state's natural resources agencies, federal agencies, and regional entities.

The Oregon Explorer as an access point to a suite of mapping tools and a unique and extensive archive of curated and organized information about Oregon communities and natural resources.

Entrepreneurial. On a much smaller scale and in more narrow focus areas, we operate similarly to the Desert Research Institute in that INR-IWW staff/faculty members are non-tenured, entrepreneurial and responsible for their own salaries from external grants and contracts. While this is pragmatic and has given INR-IWW a reputation of delivering high quality products, on time, and within budget, it also restricts our ability to be strategic.

Challenges/Vulnerabilities

Expanded reputation. As our reputation grows – not only among those we've worked with, but those who have seen our products – so does the demand for our expertise and services. However, groups who are interested in working with us or presenting ideas to us, don't necessarily bring funding to support the

work. Thus at times, supporting projects has also meant identifying funding sources, or missing the opportunity to advance worthwhile projects because they are unfunded or substantially underfunded.

Lack of necessary core financial support. Core support from the Legislature is inadequate to cover the salaries of the Director and basic support staff and related costs needed to operate. Additional unrestricted income is vital for INR-IWW to achieve its mission. This is related to the issue of what it means to be a multi-campus institute. We continue to be heavily soft-money funded, often forcing us to be more opportunistic than strategic in our projects as they relate to our focus areas. Job security for the institutes' employees is of ongoing concern.

Cyclical funding. Grants and contracts funding causes ebb and flow in INR-IWW income, and many of our projects are short-term and intensive. While working on these projects we often still need to find the next round of projects to fund us. With limited core support, we often seem to "borrow on the backs" of current projects and our staff to develop new projects.

Outreach/marketing/branding/promoting. Because many of our projects involve short time frames and small funding amounts, conducting sufficient outreach and providing product guidance and branding is often not in the scope of individual contracts.

Minimal student base. INR-IWW are not academic units, as such we don't have a regular student base of graduate and undergraduates. The majority of grants INR-IWW obtain will not support graduate student tuition, and as mentioned previously, often have too short of a time frame for graduate studies. We have been able to support Post-Doctoral Fellows, although recent changes in OSU policy are going to prevent this in the future.

Post Docs. At OSU and PSU also has a hard time funding post-docs because we are required to fund PERS even though most post-docs do not stay long enough to become vested.

Increasing costs. We continue to face increasing administrative costs at OSU (i.e., phones) and diminished services. With the implementation of the business centers, we lost our only accounting staff. This shifted many payroll and grant administration responsibilities to the director and the administrative assistant. Further, to reduce costs, the INR Associate Director position has remained unfilled for 5 years.

Shifts in work due to federal agenda. Depending on how the federal government moves with its natural resources policy, we could see shifts in our work (i.e., less funding in the areas regarding our threatened and endangered species work or natural area studies at our Portland office).

Lack of general name recognition, public awareness and visibility. Though we are gaining recognition, few people within the Oregon public universities or externally know what INR-IWW is and the products and services it offers overall, though they are familiar (and that familiarity is growing) with the work of its staff.

Deepening and broadening partnerships within the Oregon public universities and externally. INR-IWW has developed solid relationships with several state agencies and non-governmental organizations. However, it has not done so to the same extent with local government and private organizations. Faculty participation in INR-IWW projects has been limited.

Making better use of our advisory board. We can better use the board to help us develop and seek bold new opportunities that make use of the current talent and capacity with in INR-IWW.

Opportunities

- Engaging in INR-IWW's 2018+ strategic planning process – involving INR staff, the advisory board, and the review team to develop new (if necessary courses of strategy and action)….
- With state budget cuts, there might be a push for data management and information access efficiencies across the agencies.
- Some federal agencies have approached us recently to make sure funds for particular projects we have with them are allocated to us before any major shifts in policy, or to have us do work that the current hiring freeze prevents them from doing internally. These are good short-term opportunities, but depending on where the feds head, budget cuts, etc. perhaps not long-term.
- If capacity for science synthesis at the federal level declines, there may be increased demand for such work at the state or regional level.
- Opportunities exists to work with other universities and libraries around the West to provide access to our historical, current and future projections of environmental change (land, biota, and water).
- Make Oregon public universities' data and information more accessible to extend the reach of research to decision-making and new areas of research.
- We have engaged in work that links conservation planning and transportation planning, and have been asked to extend that work to other areas of infrastructure.
- Find opportunities for INR-IWW staff to teach or co-teach classes; including Extend Learning.
- Increase connection and opportunities with the Division of Outreach and Engagement.
- Initiative ideas that fall within our strategic plan goals (see Appendix D) but need funding:
    - State of Oregon Research Atlas: Natural Resources and the Environment – an effort to create and present a spatial overview of interdisciplinary research within the INR-IWW focus areas within the state of Oregon. This effort would better connect research to management and decision making and better connect INR-IWW to the universities. This effort would start with a pilot of one or two focus areas, using existing information available through the Research Offices at OSU, PSU, and UO.
    - "Oregon's Talking Landscapes" Initiative – an initiative linking university-based research, data, and models projecting the future; art; citizen science, and oral history to tell a broader story of environmental change and coupled human and natural systems in Oregon. This initiative would deeply link the public universities, community colleges, and K-12 with agencies and other decision makers; tie into STEM and the Next Generation Science Standards. Products would be place-based, support citizen science, and available online through the Oregon Explorer.

- Nationwide Predictor and Model Development – an effort to build a consortium of 10 U.S. public universities – OSU, Colorado State University, Michigan State University, University of Wyoming, University of Montana, University of New Mexico, University of Oklahoma, Florida State University, State University of New York College of Environmental Science and Forestry (SUNY ESF), and Auburn University – to create national-scale predictor data, R-scripts, best practices, and high-resolution models for threatened and endangered species or wetlands to be used in U.S. regulatory decision support tools.
- Coastal Ocean-Aquifer Studies (COASt) to support the Marine Studies Initiative, Newport, OR - Oregon State University (OSU) and the other flagship universities conduct very little research on nearshore and offshore aquifers. In a 2013 review article in *Nature*, researchers posit that the volume of usable offshore groundwater is 100 times greater than what has been extracted from the Earth's subsurface since the start of the 20th century. This water source option has gone largely unexplored off the Oregon coast as no offshore drilling for oil and gas has occurred along Oregon coast since the 1960s. IWW was invited to present Oregon's concept in Onshore-Offshore Drilling and Sampling to Understand Freshwater Resources along the New England Continental Shelf: An IODP-ICDP Workshop, May 22-23, 2017, Woods Hole, Massachusetts to initiate national and international partnerships.

Opportunities to attract additional resources

We have identified several potential ways to attract additional resources for both core support and in grants and contracts. These potential sources are listed below, but not prioritized:

Core Support

- Private fundraising to support faculty, graduate students, professional development and space needs
- New methods to obtain returned overhead or other compensation for multi-disciplinary proposals we write, coordinate and manage
- Targeted funds for INR to manage proposal development on large, multi-disciplinary research projects (as determined by the Vice Presidents of Research at OSU, PSU, and UO)

Soft Funds

- Build or expand mechanisms for fee-for-service.
- Longer-term sponsorships for OE (sponsorship of each OE topic and/or basin site)
- Seek out unconventional connections/supporters to partner and collaborate with.
- More actively seek targeted funding from foundations and other private sources for initiatives in key focus areas (Initiatives such as: COASt, Oregon's Talking Landscapes, State of Oregon Research Atlas: Natural Resources and the Environment, Nationwide Predictor and Model Development, etc.)
- Continue to identify and compete for multi-year federal funding working with multi-campus interdisciplinary teams on topics in our focus areas
- Develop research cooperatives or multi-year funding support agreements with specific state agencies

Appendix A

Comparison of legislation and OSU Category 1 charter establishing INR

ORS	OSU Category 1 Charter
Serve as clearinghouse for scientifically based natural resources information	Provide a central, continuous coordination of information and database management and delivery for Oregon's state and federal agencies and private sector institutions
Provide scientifically based natural resources information to the public in integrated and accessible formats	Provide for shared access and use of publicly available scientific and geographic information system resources
Coordinate efforts with other state agencies and bodies to provide natural resources information to the public in a comprehensive manner	Ensure that scientifically sound and up-to-date data and resource assessments are used to support natural resource conservation and economic development decision making
Facilitate and conduct research	Provide a venue and processes for interdisciplinary research and problem solving by scientists and scholars most capable of addressing relevant problems. Decrease the time for incorporating research results into action programs and improve feedback mechanism for research refinements.
Provide information and technical tools to assist decision-making on natural resources issues	Promote critical policy analysis, increase the accuracy and precision of problem identification and improve priority setting
Assist state agencies to fulfill agency needs regarding natural resources information, research, and training	Improve public understanding of the values of natural resources and policy choices and management opportunities unique to Oregon's watersheds, counties and bioregions.

Appendix B

Responses to Oregon Ways and Means Committee questions (June 2017)

The following questions relate to the universities' core missions of instruction, research and public service. If not applicable to this particular program, just note as "n/a."

Student Participation

Describe how students (identifying undergraduate and/or graduate) directly participate in this program.
Students' direct participation in INR-IWW is project-dependent. They participate in *applied, user-inspired* research, science synthesis, data compilation, information access, convening and reporting. Since 2005, approximately 60-70 students (primarily graduate students) have directly participated with us – not including presentations in classes, classes that have been taught, seminars, or trainings.

Ability to earn academic credit hours (include number of students and total credit hours earned over most recent academic year:
We are housed under the OSU Research Office. INR-IWW is not an academic unit and therefore students can not earn academic credit hours within INR-IWW; however, INR-IWW staff have taught classes aligned with other academic units (e.g., in the past INR staff have taught FOR444, Ecologic Aspects of Park Management; and IWW staff teach three courses per year –two at OSU for three credit hours each and one at UO Law School for four credit hours).

Ability to gain experience in field of interest, research projects, dissertation material or other factors (include number of students annually):

- Approximately 1-3 students annually.
- Students participate in applied, ***user-inspired research, science synthesis, and information access projects*** that give them hands-on experience in linking science, data, and information to natural resources decision making.
- Students have conducted their Master's level, non-thesis capstone projects within INR-IWW for programs and units such as the Professional Science Master's Program, Environmental Sciences Program, the Marine Resource Management Program, the Water Conflict Management and Transformation Certificate Program, and the School of Public Policy.
- Students gain experience in transdisciplinary research project design and management by participating in INR-IWW projects and gain experience presenting their work to diverse audiences, including state and federal agency executives and personnel, legislators, and other stakeholders. Nearly $10,000, in the last biennium, was secured to support student workers to work on INR's Oregon Explorer (http://oregonexplorer.info/) – natural resources digital library that provides access to integrated natural resources information organized by topic, location and data portals. Through Oregon Explorer (OE), users can interact with place-based, up-to-date scientific information through maps, charts, data, images, publications, and visualization tools. This is in collaboration with the OSU Libraries and Press.
- Students participate in INR's Oregon Biodiversity Information Center (ORBIC), which works with partners across the region to provide the most comprehensive information on plants, wildlife,

fish, fungi, and vegetation communities throughout Oregon – including the most comprehensive database of rare, threatened and endangered species of Oregon.
- A formal assessment of the WW2100 stakeholder engagement process was the subject of an OSU master's thesis (Ferguson, 2015; Ferguson et al., 2016).

Describe student Internships or employment (include number of student workers/graduate assistants annually):

- Internships are required for a few programs at OSU (noted above). On average, INR-IWW has 1 to 3 interns per year from these programs.
- INR-IWW (Corvallis) employs 1 to 2 undergraduate or graduate students as research assistants per year; our Portland office employees 2-3.
- This year, there are 10 seasonal biologist positions, which provide field experience for students, recent graduates and graduate assistants, and 4 seasonal biologist positions at PSU to support students or provide experience to recent graduates.

Describe any indirect benefits to university students through the university's participation in this program:

- INR-IWW staff serve on graduate committees.
- INR-IWW staff have been guest lecturers in OSU, PSU, and UO classes.
- Students have access to data and information via the Oregon Explorer. At least 8% of Oregon Explorer users are students and that at least 12 OSU classes use the Oregon Explorer.

ANTH 499	Special Topics – Rural Anthropology
ANTH 581	Natural Resources and Community Values
CSS/GEO 335	Introduction to Water Science and Policy
GEO 365	Introduction to Geographic Information Systems (GIS)
GEO 423	Land Use
GEO 465/565	GIS and Science
FW 435/535	Wildlife in Agricultural Ecosystems
FW 445/545	Ecological Restoration
SOC 475	Rural Sociology
BA 363	Technology and Innovation Management
BA 260	Introduction to Entrepreneurship
BA 101	Business Now
WRP 599	Business of Water

- Students have access to threatened, endangered, native and invasive species data and information available through INR's Portland Office, Oregon Biodiversity Information Center (ORBIC) for class work and projects.
- IWW funds graduate student hydrologic events such as an annual water symposium and field trips.
- Students have access to reports, data, and maps that we produce including videos such as "Stormwater Solutions for the Willamette Basin" and "Umatilla Basin Groundwater Depletion".
- Student work is highlighted on our website, such as The Oregon Water Atlas (http://oregonwater.info/) by undergraduate student, Gareth Baldrica-Franklin.

Research

Describe how this program leverages state funding, noting recent research awards and dollars, published results, national or global recognition, etc.

Annually, INR-IWW brings in between five to ten times its dedicated state appropriations via contracts and grants. Two projects illustrate some of our work and recognitions:

- With the USFS Pacific Northwest Research Station, INR was the lead institution in a multi-year, $5 million effort (the Integrated Landscape Assessment Project (ILAP)) to produce information, maps, and models to help land managers, policy-makers, and others conduct mid- to broad-scale (e.g., watersheds to states and larger areas) prioritization of land management actions, perform landscape assessments, and estimate cumulative effects of management actions for planning and other purposes. ILAP has been being used in forest plan revisions.
- INR led a national team in developing the nine-step Integrated Ecological Framework (the IEF), which is designed to support and promote integrated transportation and conservation planning while expediting transportation project delivery. The IEF is a congruent science-based, technical framework to the Eco-Logical approach, developed by eight Federal agencies in 2006, which recommends a collaborative, integrated, watershed or ecosystem scale approach to *decision-making during infrastructure planning*, *environmental review*, and *permitting*. Extensive science and literature review, and national outreach was conducted to create the IEF. The IEF was selected by the Federal Highway Administration and American Association of State Highway and Transportation Officials (AASHTO) for national implementation.

More of our work is highlighted in this February 2016 document (http://online.pubhtml5.com/azbh/hlwh/#p=1) and publications and other products are available on our website (http://inr.oregonstate.edu/products).

Public Service

Describe how this program directly serves Oregonians or the local/regional community, providing metrics over time as applicable and available. Include any economic impact on local, state, national, or global economies.

- Providing access to natural resources data and information is our legislative mandate.
- Developing data to support natural resources uses: a) developers and public agencies rely on INR information to avoid project delays due to unforeseen environmental impact; b) public land management agencies rely on INR data and expertise to promote decisions and natural resource uses; c) INR creates basic framework data that supports development and public safety across the state; and d) INR provides support to legislators, federal and state agencies, and local government to assist in addressing science questions without bias, by working with the best expertise in Oregon's public universities.
- Funded partnerships with 6 state agencies: The Department of Administrative Services (DAS), the Department of Land Conservation and Development (DLCD), the Oregon Department of Forestry (ODF), the Department of State Lands (DSL), the Oregon Department of Fish and Wildlife (ODFW), and the Oregon Watershed Enhancement Board (OWEB).
- Funded partnerships with 6 federal agencies: The U.S. Environmental Protection Agency (EPA), U.S. Forest Services (USFS), the U.S. Geological Survey (USGS), the Bureau of Land Management (BLM), the National Park Service (NPS), and the U.S. Fish and Wildlife Service (USFWS).
- Funded partnership with the Washington State Legislature.

- Funded projects through the Oregon State Legislature – most recently SB202 (the Task Force for Independent Science Review for Natural Resources in the State of Oregon); and HB2998 to help the Oregon Business Development Department (OBDD) provide economic development assistance to persons engaged in business of western juniper harvesting or of manufacturing products from western juniper by identifying and mapping high quality marketable stands of western juniper that can be harvested in a commercially and environmentally reasonable manner for use in manufacturing.

Describe any indirect benefits to Oregonians from this program:

- Communities have used information made available to them for planning projects, grants, and general information about their communities and landscapes.
- 2-3 trainings per year given to K-12 teachers through our partners (Jim Proctor, Alder Creek Community Forest and Lewis & Clark College)
- INR played a leading role in developing the *Oregon Sage-Grouse Action Plan*. INR-Corvallis oversaw the full SageCon partnership and hosts the final *Action Plan* on the Oregon Explorer web, and INR-Portland led the technical portions of the immense planning effort. The *Oregon Sage-Grouse Action Plan* won final state approval through an executive order issued by Governor Kate Brown on September 17, 2015. This, and similar work in other states, led to the USFWS's September 2015 decision to not extend Endangered Species Act protections to the greater sage-grouse across its range in eleven states and three-Canadian provinces. Oregon's *Action Plan* was among the strongest of the state plans developed across the sage-grouse range and provided key portions of the evidence the USFWS used to justify its decision. INR has helped to call national attention to the work that Oregon is doing in linking transportation and conservation planning.
- Through workshops and fieldtrips, the IWW's Willamette Water 2100 project created a forum for conversations about water in the Willamette Basin.

How does this program (or could it) provide meaningful information to assist the State Legislature?

- Science synthesis and review processes used by INR-IWW could help increase the objectivity, transparency, and utility of the resulting science "package" delivered to policymakers and practitioners around an issue of interest by the legislature.
- Information and data made publicly available through the Oregon Explorer can be and is being used to inform decisions.
- Science synthesis and reviews: SB202 which led to SB198 – process for thinking about how third-party independent science reviews for natural resources benefit forward-looking, multi-agency natural resources management.
- Produced a video on Umatilla groundwater depletion which led to the funding of a $2m feasibility study for aquifer storage and recovery.

The following questions pertain to the relationship between this individual program and the university as a whole.

Describe how each program is integrated into the institution in terms of sharing of staff, facilities, student participation (see above), and community (defined broadly).

- INR-IWW, began a merging process in 2014. In addition to sharing staff, the programs are co-located, and share a board of advisors. INR-IWW is part of a cohort of Research Centers and Institute Directors, who meet quarterly to help with strategic planning and moving the research enterprise forward.

- OSU Libraries and Press give some space to our Oregon Explorer Program, and also have staff participate in this program.
- The IWW Collaboratory is a shared laboratory that provides Oregon State University affiliates with access to low cost trace level, fresh water analysis instrumentation and procedures. Researchers can receive training on instrumentation and analyze samples themselves, or they can pay staff to run analyses for them. The goals are to encourage cooperative research' to provide access to quality instrumentation dedicated to fresh water analyses; to provide laboratory training opportunities, and to help researchers minimize water analysis costs.

Describe the program's staffing including FTE and the relationship of the staff to the overall university.

- INR-IWW currently has 20 full- and part-time staff members, and 10 temporary staff. Total FTE 25.96. Staff have PhDs, Masters, and/or Bachelor's degrees. Staff are specialists in science synthesis, modeling, geographic information systems and remote sensing, outreach and engagement, project management, facilitation, and research with the INR-IWW focus areas.
- Relationship to university: INR-OSU staff are housed within the OSU Research Office and some have adjunct or courtesy appointments with various programs on campus, including: the Environmental Science Program, the Water Resources Graduate Program, the Professional Science Master's Degree, and the Sustainability Dual Degree Program. INR-IWW collaborate with the OSU Libraries and Press, Department of Geosciences, the Marine Resource Management Programs, and the School of Public Policy. INR-PSU staff are housed within the School of the Environment within the College of Liberal Arts and Sciences.

Are the employees university faculty, staff, or students, or is there another relationship, such as an affiliated nonprofit or other entity?

- All INR-IWW staff are university employees.

Describe how the program is "subsidized" or assisted by the university(s) including use of facilities (e.g., does program pay rent), central staff, central services, sponsoring of conferences, and other activities.

INR-IWW is organizationally under the OSU Research Office and the Portland Office is under the PSU College of Liberal Arts and Sciences. INR-IWW is assisted by these units through: space; most utilities (heating, lighting, some IT, etc.); some central services such as finance, human resources, proposal routing, and research compliance; and a core operating budget. OSU provides cost-share match for U.S. Geological Survey funds for IWW.

How is the program evaluated -- please describe any internal measures that are used, any institution based system or process, any outside "industry" reviews.

Evaluation (Table 1) was written into our current 2013-2017 Strategic Plan and states that, "a programmatic review will occur during the fifth year of the strategic plan (2017) and will help shape the 2018-2022 strategic planning process". INR-IWW is scheduled to go through an OSU Research Office Support Unit Program Review on 10-11 August 2017; these reviews are conducted in 5-year cycles for all OSU Research Office Centers and Institutes. Six reviewers have been selected by the OSU Research Office to conduct the review. IWW undergoes a separate national program evaluation through the USGS every three years, and is scheduled for review in August 2017.

Table 1. Indicators of performance from the 2013-2017 INR Strategic Plan	
Quality	• *Timeliness:* INR's ability to provide support to clients and users within a timeframe consistent with the expectations of the groups engaging with the INR. • *Client and user satisfaction*: The extent to which clients and users are satisfied with INR's processes, services, products, and outcomes. • *Collaborations:* The usefulness of INR's processes for engaging partners, collaborators and other stakeholders, and incorporating input.
Outputs	• *Quantity of products*: The quantity of relevant, credible, and useful products produced. • *Use of products:* (1) The extent to which available INR products are believed by partners, collaborators and other stakeholders to be relevant, credible, and legitimate to natural resources planning, management, and/or policy; and (2) the degree to which INR products and services have the potential to influence desired outcomes and/or change behaviors by clients and users. • *Usability of products*: An assessment of the usability of INR processes, services, and products, including whether or not using INR was worth the effort
Outcomes/Impact	• *Information support:* Extent to which INR work assists in natural resource-related decision making. • *Decision quality:* The extent to which INR clients and users believe that the process leading to a decision and an expected outcome(s) of the decision were the best that could be made with available information.

Appendix C

Timeline of INR and IWW history

Year	Event
1961	Water Resources Research Institute (WRRI) at Oregon State University was authorized and funded by the Oregon State Board of Higher Education.
1964	Water Resources Research Act of 1964 officially creates a network of water resource research institutes at land grant universities across the U.S.
1980s-2000s	The Water Resources Research Institute (WRRI) changes its name to the *Oregon Water Research Institute* (OWRI) then changes to the *Center for Water and Environmental Sustainability* (CWESt). CWESt had focus and programs beyond water, but water research was an essential part of it.
2001	Oregon Sustainability Act (HB3948) establishes INR as an Oregon University System institute.
2001 (Sept)	Category 1 establishes INR as an institute within Oregon State University
2003 (July)	INR hires with first Director.
2005 (July)	IWW is established via an OSU Provost Initiative to address the growing focus on water and watersheds.
2005 (Aug)	CWESt closes with its duties being redirected to individual institutes – IWW, INR, and the Western Region Hazardous Substance Research Center.
2009	INR amends legislation so that its INR-Portland Office can relocate on the Portland State University campus.
2010	OSU and PSU finalize memorandum of understanding about how INR will operate on the two campuses.
2014	Vice President of Research Rick Spinrad and Associate Vice President of Research state, and INR Board of Advisors agree, that INR and IWW should re-merge.
2015	INR and IWW begin to informally merge.
2017	OSU-PSU memorandum updated.

Appendix D

Draft goals and strategies for the process of updating the current INR-IWW strategic plan

To develop the "2018+ INR-IWW Strategic Plan", should there be:

- *A "tactical" refreshing of the strategic plan?* (Minor adjustments in how our mission and goals are implemented. Re-examining "how" INR-IWW should achieve its goals, while keeping the goals and strategies in place)
- *An "operational" refreshing of the strategic plan?* (Same mission, new area or method of work – scale, scope, intensity; change of emphasis.)
- *A "strategic" refreshing of the strategic plan?* (A fundamental rethinking of our purpose and goals – meaning the mission needs to be changed with major changes in the way we are structured, funded, and measured for impact.)

Do we revisit our vision and mission?

Vision and Mission

☐ Vision. Our vision is that people and organizations routinely use INR-IWW services and products to meet environmental, economic, and social challenges of this and future generations.

☐ Mission. Provide access to integrated knowledge and information to inform natural resource decision making and develop solutions in the context of sustainability.

Draft goals to consider/revise from current strategic plan

Goal 1: Increase the ability of others to efficiently and effectively deliver environmental and resource outcomes.

Strategies

☐ 1. Engage communities of place, interest, and practice in identifying major upcoming challenges and developing solutions.

☐ 2. Continue to enhance and maintain an easy-to-use, up-to-date web interface that others can use to access and interact with natural resource information and data.

☐ 3. Support biodiversity conservation through data collection, access and dissemination about the identification and occurrence of plant, animal, and ecological community resources of Oregon.

☐ 4. Advocate for and facilitate efficiencies in data collection, data sharing, monitoring and reporting of long-term natural resource and the environment trends and indicators.

☐ 5. Advocate for and collaborate with partners to create a dynamic, continually updated web-based "State of the Oregon Environment" reporting tool.

Goal 2: Extend the reach of knowledge and information to inform natural resource decision making.

Strategies

☐ 1. Become more integrated into the Oregon University System, their research, and their outreach and engagement activities.

☐ 2. Increase the visibility, usefulness, and impact of university research products on natural resource decision making and policy making.

☐ 3. Facilitate university-agency interactions that promote the appropriate use of available science, technology, and information in natural resource decision-making.

☐ 4. Facilitate experiential student learning.

Goal 3: Enhance the relevance and delivery of a distinctive suite of services and products.

Strategies

☐ 1. Conduct a needs assessment with stakeholders about INR services and products.

☐ 2. Fully integrate INR products into the Oregon Explorer.

☐ 3. Provide broader access to and applicability of client- and grant-based research and information products.

Goal 4: Strengthen INR's capacity and effectiveness.

Strategies

☐ 1. Secure sufficient, unrestricted funds from a variety of sources to support INR's core functions, while maintaining the flexibility to expand and contract staffing based on workload.

☐ 2. Become a people-centered organization that emphasizes collaboration, innovation, learning, and rewards.

☐ 3. Operate our offices with adequate organizational support, staffing, and infrastructure to advance our mission and goals.

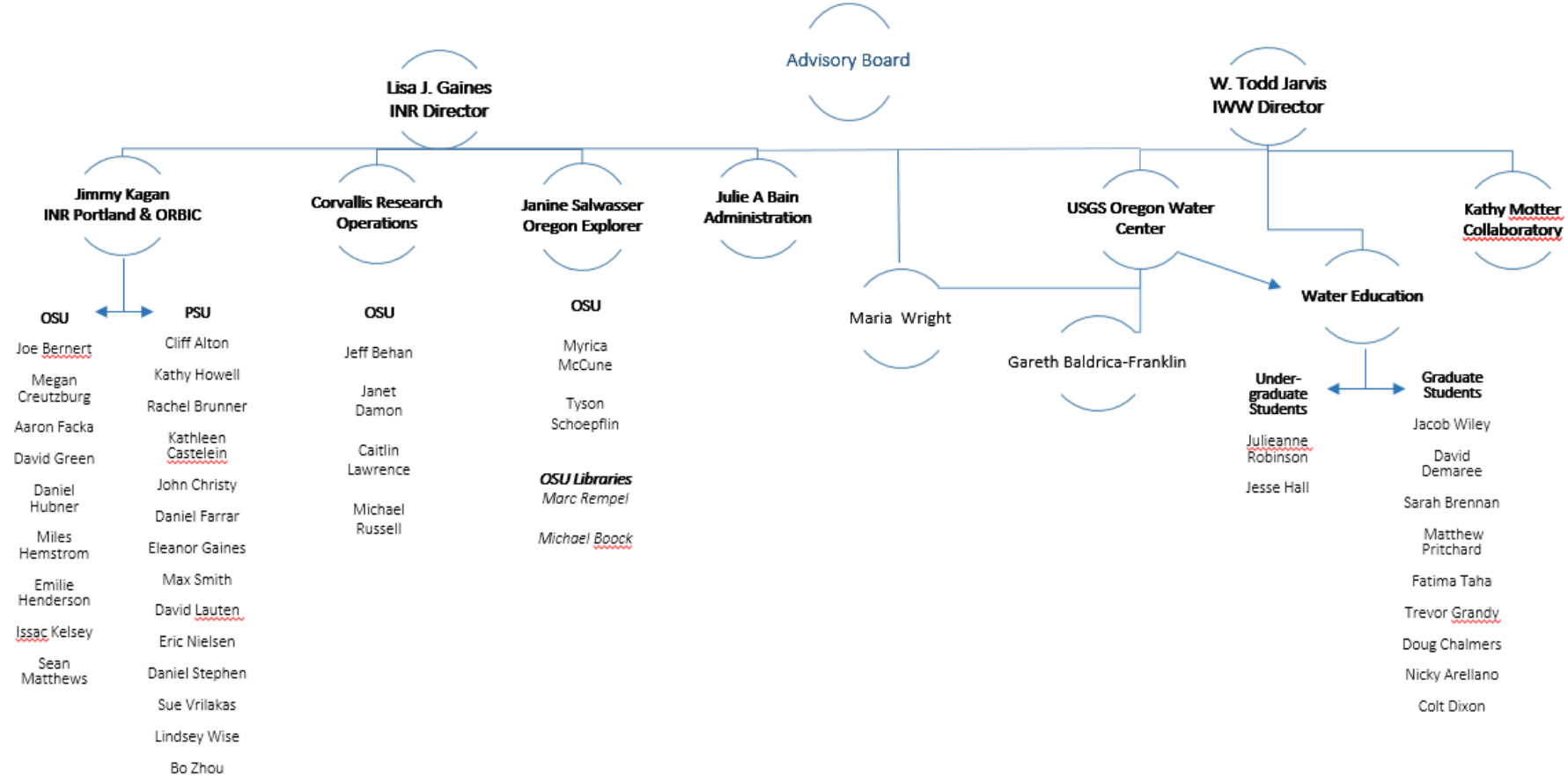
☐ 4. Increase INR visibility and branding.

Other goals to consider

- Provide innovative venues and methods for integrating scientific and local knowledge in the pursuit of sustainable Oregon ecosystems.
- Leverage existing excellence at OSU to secure external funding from new sources…

Appendix E

INR-IWW organizational chart



Appendix F

List of INR-IWW grant-funded projects: FY11-FY17

FY11

Utilities and Corporations as Ecosystem Services Buyers: Innovative Opportunities for Small- and Medium-sized Farms and Rural Communities. *U.S. Department of Agriculture*. $498,496.

New Natural Resource Economy Opportunities for Rural Economic Development. *Ford Family Foundation*. $10,000.

Local Ecosystem Services Marketplaces: Public Utilities as Development Drivers. *Bullitt Foundation*. $50,000.

Oregon Department of Forestry Science Review. *Oregon Department of Forestry*. $97,708.

Oregon Hazards Explorer: Phase 2. *Oregon Department of Land Conservation and Development*. $25,000.

OWEB Online Watershed Restoration Visualization Tool Maintenance & Enhancement. *Oregon Watershed Enhancement Board*. $8,151.

Data Management Meeting Facilitation. *Oregon Department of Land Conservation and Development*. $6,551.

Measure 49/SB 1049 Map Viewer Enhancement. *Oregon Department of Land Conservation and Development*. $2,500.

Understanding Risks to the Portland-Vancouver Urban Ecosystem from Climate Change: Interacting Drivers and Vulnerabilities from Complex Socio-Ecological Systems. *National Science Foundation*. $84,241.

Oregon Coastal and Marine Data Network Workshop. *Bureau of Ocean Energy Management, Regulation and Enforcement*. $3,413.

Estuaries, Climate Change and Conservation Planning Workshop. *Defenders of Wildlife*. $3,669.

Oak Savannah, Sagebrush, Climate Change and Conservation Planning Workshop. *Defenders of Wildlife*. $9,466.

Oregon Transportation Portal - Phase 1. *Oregon Department of Transportation*. $13,770.

USGS State Water Resources Research. *U.S. Geological Survey.* $92,335.

Army Visiting Scholars Program. *Army*. $40,000.

Anticipating Water Scarcity in the Pacific Northwest. *National Science Foundation*. $3,832,363.

Vegetation Mapping at Olympic National Park. *National Park Service*. $377,273.

BLM Western Snowy Plover Monitoring and Nest Protection Coos Bay District, Oregon. *Bureau of Land Management*. $ 446,000.

Inventory of Vernal Pools on BLM Klamath Falls Resource Area. *Bureau of Land Management*. $11,999.

FY12

ILAP: Integrating Watershed Restoration into an All Lands Management Framework. *U.S. Forest Service.* $312,155.

Oregon Transportation Portal Phase 2 for the Oregon Spatial Data Library. *Department of Administrative Services.* $45,000.

Oregon Wetland Assessment Protocol Enhancements. *Department of State Lands.* $19,733.

USGS State Water Resources Research. *U.S. Geological Survey.* $92,335.

Army Visiting Scholars Program. *Army*. $40,000.

Oregon Wetlands Explorer Statewide Wetland Prioritization Tool. *Environmental Protection Agency.* $128,973.

Programming Polasky's Biological Model and Wildlife Analysis *U.S. Fish and Wildlife Service.* $393,349.

Stewardship - Snowy Plover Nest Monitoring and Protection (FY12). *U.S. Forest Service.* $71,000.

Designing a Database of Economic Information Related to Northwest Forest Industrial Activities in Oregon, Washington and Alaska. *U.S. Forest Service.* $52,370.

Oregon Dunes Vegetation Assessment. *U.S. Forest Service.* $17,602.

Completion of GIS Maps of Whitebark Pine Communities at Crater Lake National Park, Oregon. *National Park Service.* $4,193.

CESU/Vegetation Mapping at North Cascades National Park. *National Park Service.* $393,349.

Evaluation of Western Juniper Removals in Eastern Oregon since 1970. *Natural Resource Conservation Service.* $75,000.

CESU Oregon Biodiversity Information Coordination, Oregon State Office, Portland, Oregon. *Bureau of Land Management.* $303,804.

Wetland Classification, State and Transition Modeling and Mapping at Malheur National Wildlife Refuge. *U.S. Fish and Wildlife Service.* $30,845.

FY13

Nearest Neighbor. *U.S. Forest Service.* $23,965.

Virtual Research and Learning Centers Network Management. *National Park Service.* $24,000.

Oregon and California Lands: Forest Health Economic Assessment. *Mason, Bruce & Girard, Inc.* $57,788.

West Coast Science Panel for Ocean Acidification and Hypoxia. *Department of Land Conservation and Development.* $25,000.

Western Landscapes Explorer: Landscape Assessment Database. *The Keystone Center.* $9,534.

Sagebrush Steppe Inventory and Analysis. *Nature Conservancy.* $60,000.

Building a Water Quality Station and Data Map Viewer. *Department of Environmental Quality.* $10,000.

Oregon Explorer Planners' Sub-portal. *Department of Land Conservation and Development.* $15,000.

DLCD Endangered Species Act Workgroup. *Department of Land Conservation and Development.* $15,000.

Oregon Coastal Marine Data Network Internship. *Department of Land Conservation and Development.* $14,954.

Olympic Peninsula Analysis and Path Software Update. *Washington Department of Natural Resources.* $25,000.

Climate, Land Management and Future Wildlife Habitat in the Pacific Northwest. *U.S. Geological Survey.* $130,709.

USGS State Water Resources Research. *U.S. Geological Survey.* $55,525.

Army Visiting Scholars Program. *Army*. $40,000.

BEST Solar Water Treatment. *Built Environment and Sustainable Technologies*. $53,011.

Western Snowy Plover Management and Nest Protection 2013-USFS. *U.S. Forest Service.* $70,000.

Historical Wetland Mapping Project. *Cowlitz Tribe; Environmental Protection Agency.* $27,839.

Western Snowy Plover Management and Nest Protection for 2013. *Oregon Department of Fish and Wildlife; and the U.S Fish and Wildlife Service.* $45,000.

2012/2013 Snowy Plover Recovery – USFWS. *U.S. Fish and Wildlife Service.* $32,163.

All Lands, All Threats Plan for Sage Grouse Project. *Oregon Watershed Enhancement Board.* $350,000.

OPRD Snowy Plover Monitoring 2012-13. *Oregon Parks and Recreation Department.* $100,000.

Updating Oregon's Forest Biodiversity Data for Important Species and Habitats. *Oregon Department of Forestry.* $9,974.

Developing Cost-Effective Approaches to Meet Title 13 Reporting Requirements. *Metro.* $11,585.

Historical Wetlands Mapping - Douglas County. *Douglas County.* $3,402.

FY14

Southwest Crown of the Continent Monitoring Review. *USDA Forest Service* $8,022

Incorporating Elements from Western Landscapes Explorer into the Landscape Conservation Cooperative Integrated Data Management Network Project. *U.S. Geological Survey.* $4,997.

The Emergency Preparedness Framework Data Project. *Oregon Department of Environmental Quality.* $12,760.

Oregon Wetlands Explorer Statewide Wetland Prioritization Tool. *Portland State University.* $35,938

All Lands, All Threats Plan for Sage Grouse Project. *Portland State University.* $17,777.

Southwestern Oregon Potential Vegetation -- Map Refinements. *Bureau of Land Management.* $18,906.

Integrated Conservation Framework Step 6: Ecosystem Services Crediting System Implementation. *ICF International.* $145,208.

USGS State Water Resources Research. *U.S. Geological Survey.* $92,335.

Army Visiting Scholars Program. *Army*. $40,000.

Anticipating Water Scarcity in the Pacific Northwest. *National Science Foundation*. $15,044.

Oregon Wetlands Explorer Statewide Wetland Prioritization and Ecosystem Services Assessment. *Environmental Protection Agency.* $299,874.

Historic Vegetation Database. *U.S. Forest Service.* $50,000.

Climate, Land Management and Future Wildlife Habitat in the Pacific Northwest. *U.S. Geological Survey.* $48,362.

Snowy Plover Nest Monitoring and Protection FY14. *U.S. Forest Service.* $70,000.

Western Snowy Plover Nest Monitoring and Protection 2013. *U.S. Fish and Wildlife Service.* $30,000.

Developing a Landscape-Scale Mitigation Program for Sage Grouse. *Oregon Department of Fish and Wildlife.* $375,000.

Developing a GIS Layered Tree Map of Canopy Cover. *Oregon Department of Fish and Wildlife.* $4,900.

All Lands All Threats Plan & Implementation for Sage Grouse II. *Oregon Watershed Enhancement Board.* $69,654.

FY15

Available Science Assessment Project: Evaluating the Supporting Science behind Climate Adaptation Actions -- Prescribed Fire. *U.S. Geological Survey.* $109,953.

External Review of Oregon Invasive Species Council. *Oregon Department of Agriculture.* $5,000.

Facilitating the Capability Workshop for Climate Change Extension and Research Leaders in Idaho, Oregon, and Washington. *University of Idaho.* $3,365.

ODFW SageCon Project Management. *Oregon Department of Fish and Wildlife.* $19,550.

Greater Sage Grouse Conservation Plan (SageCon) Implementation. *Oregon Watershed Enhancement Board.* $182,126.

ODLC SageCon Project Management. *Department of Land Conservation and Development.* $19,595.

Integrated Landscape Assessment Project. *USDA Forest Service.* $186,696.

Demonstrating How Vulnerability Assessments Can Support Military Readiness. *NatureServe.* $26,609.

ODFW Oregon Framework Fish Passage and Fish Habitat Distribution Data Development Support. *Oregon Department of Fish and Wildlife.* $10,643.

Forest Change Analysis Project. *Oregon Department of Forestry.* $54,528.

OE Land Use Planners Content. *Department of Land Conservation and Development.* $54,525.

USGS State Water Resources Research. *U.S. Geological Survey.* $92,335.

Stewardship-USFS Snowy Plover Nest Monitoring. *U.S. Forest Service*. $70,000.

Mapping and Modeling the Vegetation at the Naval Weapons Training Facility, Boardman. *The Nature Conservancy* and the *Department of Defense.* $22,949.

ODFW/USFWS Snowy Plover Nest Monitoring 2014. *Oregon Department of Fish and Wildlife* and *U.S. Fish and Wildlife Service.* $50,000.

ODFW/USFWS Western Snowy Plover Nest Monitoring 2015. *Oregon Department of Fish and Wildlife* and *U.S. Fish and Wildlife Service.* $50,000.

USFWS 2014 Western Snowy Plover Nest Monitoring and Protection. *U.S. Fish and Wildlife Service.* $30,000.

The Identification and Evaluation of Five Natural Areas as Potential National Natural Landmarks in the Pacific West Region. *National Park Service.* $30,000.

Conservation Strategy Habitat Map for Oregon. *Oregon Department of Fish and Wildlife.* $25,332.

OWEB SageCon Project Management. *Oregon Watershed Enhancement Board.* $4,471.

Research and Survey for Plants at the Former Blue Heron Paper Mill at Willamette Falls. *Metro.* $10,000.

FY16

The Available Science Assessment Project (ASAP): Evaluating Adaptation Actions for Sea Level Rise and Coastal Change in the Pacific Northwest. *U.S. Geological Survey.* $91,000.

UCC Roseburg Facilitation. *Portland State University.* $44,866.

ODLCD SageCon Project Management. *Department of Land Conservation and Development.* $57,465.

Northern Sierra Nevada Fisher translocation Continuity and Modeling Fisher Habitat Relationships Using Female Reproduction as a Direct Measure of Fitness on Hoopa Valley Reservation, California. *U.S. Fish and Wildlife Service.* $163,450.

Imperiled Fisher Conservation: Northern Sierra Nevada Fisher Translocation Continuity and Modeling Fisher Habitat Relationships using Female Reproduction as a Direct Measure of Fitness on Hoopa Valley Reservation, California. *The Volgenau Foundation.* $45,000.

Stream Classification Map Viewer. *Willamette Partnership.* $10,000.

Sagebrush State and Transition Model Mapping Test. *Nature Conservancy.* $2,321.

Modeling the Distribution of Gorse along the SW Oregon Coast using Random Forest. *New Venture Fund.* $13,936.

Oregon Explorer Western Wildfire Risk Assessment Project. *Oregon Department of Forestry.* $130,500.

SB202: Independent Science Review for Natural Resources in the State of Oregon. *Oregon Legislature.* $109,000.

Oregon Explorer Wildfire Risk Project Coordination. *Oregon Department of Forestry.* $113,904.

Land Use Planning Support Phase 3. *Department of Land Conservation and Development.* $53,363.

Oregon Explorer and Watershed Restoration Tool Support. *Oregon Watershed Enhancement Board.* $37,266.

SageCon Action Plan Implementation Project. *Oregon Watershed Enhancement Board.* $281,471.

Implementation of an Oregon Stream Function Assessment Method (SFAM) tool on the Oregon Explorer Portal. *Department of State Lands.* $100,115.

2016 Western Snowy Plover-Monitoring, Install Nest Enclosures and Record Human Disturbance in Oregon. *Oregon Department of Fish and Wildlife* and the *U.S. Fish and Wildlife Service.* $60,000.

Juniper Mapping for Economic Development. *Oregon Legislature.* $100,000.

CESU-ORBIC Western Snowy Plover Monitoring and Nest Protection. *Bureau of Land Management.* $300,500.

USGS State Water Resources Research. *U.S. Geological Survey.* $92,335.

USGS State Water Resources of the Luquillo Mountain. *U.S. Geological Survey.* $7,188.

2016 Western Snowy Plover Nest Monitoring & Protection. *U.S. Fish and Wildlife Service.* $80,944.

Olympic National Park Vegetation Inventory & Map Product Development. *National Park Service.* $82,097.

Oregon Clean Water Partnership Project. *Oregon Watershed Enhancement Board.* $45,653.

ODFW SageCon Project Management. *Oregon Department of Fish and Wildlife.* $77,478.

Implementation of an Oregon Stream Function Assessment Method (SFAM) tool on the Oregon Explorer portal (from DSL via OSU). *Environmental Protection Agency.* $14,763.

New River ACEC: Vegetation Community Association Mapping. *Curry County Soil & Water Conservation District.* $9,674.

FY17

Investigating the Effects of Mixed-Severity Wildfires and Timber Harvest Management on Interspecific Competition and Population Dynamics of the Mesocarnivore Guild in Northern California and Southern Oregon. *U.S. Fish and Wildlife Service.* $153,000.

Sage-Grouse Development Registry Application. *Oregon Department of Fish and Wildlife.* $30,000.

Ecological Effects of Tide Gate Improvement or Removal: A Literature Review. *Oregon Watershed Enhancement Board.* $38,304.

Sage-Grouse Development Registry Application. *Oregon Department of Land Conservation and Development.* $53,000.

Oregon Assessment Partnership Project. *Portland State University.* $14,927.

Eastern Washington Forest Restoration Modeling Project. *Washington Department of Natural Resources.* $51,613.

Supporting Recovery Planning, Management and Conservation: Evaluating the Success of Translocating Fisher (Pekania pennanti) to Increase the Statewide Distribution (Phase 3). *California Department of Fish and Wildlife.* $96,283.

Outcome Measures for Habitat and Recreation Acquisitions and Environmental Regulations. *Washington State Legislature, Joint Legislative Audit.* $98,088.

USDA Survey & Monitoring Fishers in Oregon. *U.S. Forest Service.* $50,005.

Monitoring Fishers (Martes pennanti) on the Klamath National Forest Following Removal of Fishers for Translocation to the Northern Sierra Nevada. *California Department of Fish and Wildlife.* $66,779.

Conserving Old-Growth Forest Components and Processes: Reproductive Den Trees of Fishers on the Hoopa Valley Indian Reservation. *California Department of Fish and Wildlife.* $92,200.

Field Testing the Habitat Quantification Tool for ODFW and Willamette Partnership. *Willamette Partnership.* $13,470.

AIM Vegetation Sampling: Vegetation Map Accuracy Sampling and Species Modeling Across the Range of the Greater Sage-Grouse in Oregon. *Bureau of Land Management.* $1,111,110.

USGS State Water Resources Research. *U.S. Geological Survey.* $14,921.

Designing a Database of Forest Economic Uses in Oregon, Washington and Alaska. *U.S. Forest Service.* $29,920.

Stewardship-Snowy Plover Nest Monitoring and Protection (FY16) Siuslaw National Forest - Central Coast Ranger District ODNRA. *U.S. Forest Service.* $82,000.

Oregon Biodiversity Information Center and Biological Conservation - Task 1 - Rare & Invasive Species Information Management. *Bureau of Land Management.* $46,585.

Oregon Biodiversity Information Center and Biological Conservation - Task 2 - Sage Grouse Decision Support System. *Bureau of Land Management.* $37,018.

Oregon Biodiversity Information Center and Biological Conservation - Task 3 - Rare Species Mapping. *Bureau of Land Management.* $14,692.

Oregon Biodiversity Information Center and Biological Conservation - Task 4 - Riparian Classification. *Bureau of Land Management.* $25,871.

Willamette Basin Riparian Mapping and Assessment. *Meyer Memorial Trust.* $44,000.

Appendix G

IWW USGS Review 2014

United States Department of the Interior
U.S. GEOLOGICAL SURVEY
Office of External Research
5522 Research Park Drive
Baltimore, MD 21228
(443) 498-5505

26 September 2014

Dear Institute Directors:

I am pleased to report to you on the general findings of the 2014-evaluation panel appointed by the USGS to review the Water Resources Research Institutes pursuant to Section 104(e) of the Water Resources Research Act of 1984, as amended. As you know the period of review was 2008-2010, and each Institute submitted materials documenting accomplishments during this 3-year review period. The panel met in June and July 2014 to review the individual Institutes based on the criteria set in the Water Resources Research Act.

A detailed letter will be sent, sometime during the first two weeks of October, from the USGS to your University summarizing the findings of the evaluation panel for your Institute. I hope to have a short session at the Annual NIWR meeting, February 2015 to go over the results and answer any questions you may have on the process.

In the remainder of this letter, I will summarize the principal findings of the review panel relative to the overall performance of the State Water Resources Research Institute Program.

The review panel concluded that the vast majority of the Institutes are doing a good job with a significant subset of Institutes who are very strong and distinguished. The panel concluded that the program remains robust and are fulfilling the goals set out in the Water Resources Research Act. Specifically, the panel found that: 1) there were eight Institutes rated "outstanding"; 2) the majority of the Institutes appear as strong in this review as they did in the previous review; and 3) only one institute was recommended for probation. The panel noted three characteristics are invariably associated with strong Institutes. These are: 1) the willingness of the State or host University to provide significant levels of support, including discretionary financial support; 2) strong leadership on the part of the Institute Director; and 3) the ability of the Institute to facilitate research and information products.

The panel also would like to share their overall observations and recommendations to strengthen the program in the coming years.

- The panel recommends that the Institutes give careful consideration to developing regional conferences on water issues that cross state boundaries. Such regional conferences could bring researchers and the users of research together periodically for discussions of research findings and potential applications on a regional or national basis.

- The Water Resources Research Act clearly states that federal dollars should be used to support research, outreach, and education. Many Institutes are using their federal dollars

to support only one or two of these elements. The panel recommends a balanced program and highly encourages Institutes to consider incorporating all three elements of the Act into their program.

- The panel recommends the Institutes clearly demonstrate a positive impact on state, regional, and federal water problems in the mandated reports (e.g. annual, evaluation). Institutes should be able to clearly describe their state water issues, explain the state priorities and match the Institute research, outreach and education activities to the state water priorities.

- Institute Directors should encourage PI's funded with federal dollars to publish in peer-reviewed journals.

As always, I would be happy to discuss any of this with you. Please do not hesitate to contact me.

Earl Greene
Acting, Chief of External Research

Copy to:

William H. Werkheiser, Associate Director for Water
Jerad D. Bales, Chief Scientist for Water and Programs

Bcc:
2014 Evaluation Review Panel members

United States Department of the Interior
U.S. GEOLOGICAL SURVEY
Office of External Research
5522 Research Park Drive
Baltimore, MD 21228
(443) 498-5505

7 October 2014

Dr. Edward J. Ray
President
Oregon State University
Office of the President
600 Kerr Administrative Building
Corvallis, OR 97331-2128

Dear Dr. Ray:

The Institute for Water and Watersheds at Oregon State University receives an annual matching grant from the State Water Resources Research Institute Program administered by the U.S. Geological Survey (USGS) under the provisions of section 104 of the Water Resources Research Act of 1984, as amended. The Act requires that the Institute be evaluated periodically to determine its eligibility for continued support under the Act. The determination is based on its effectiveness in the use of its Federal grant and required matching funds in meeting the mandates of the Act.

We are pleased to inform you that the Institute for Water and Watersheds is eligible for continued support under the Act. This decision is based on a recent report and recommendation by a panel convened to evaluate the activities of the 54 institutes or centers authorized by the Act during the period 2008 through 2010.

The Panel's specific findings follow:

- The Institute for Water and Watersheds addressed the deficiencies from the previous review.
- The Panel notes that the background discussion on water issues in the state is well done and that appropriate research priorities have been chosen.
- The panel commends the University for supplying discretionary funding to the Institute.
- The "Significant Impacts and Awards" section could have been much stronger, especially the section on how work by the Institute addresses state and national water problems.
- The decision to fund only information dissemination and outreach should be reconsidered. The Water Resource Research Act states that Institutes shall engage in research, outreach and education.

The USGS looks forward to an active and mutually beneficial partnership with the Institute for Water and Watersheds. If you have any questions or concerns about these findings, please do not hesitate to contact Earl Greene (eagreene@usgs.gov), Chief, Office of External Research.

Sincerely yours,

Earl Greene
for

William H. Werkheiser
Associate Director for Water

Copy to:
Dr. Todd Jarvis, Interim Director, Institute for Water and Watersheds

Bcc:
Jerad Bales, Chief Scientist for Water and Programs
Dar Crammond, Director, USGS Oregon Water Science Center

Appendix H

IWW Annual Technical Report FY16 submitted to USGS

Introduction

Oregonians are witnessing the difficulties caused by water limitations. Water quantity and quality issues in the Willamette, Klamath, Deschutes, and Umatilla Basins are the Governor's top environmental and water allocation priorities. For example, Governor Brown declared a drought in the southern part of the typically water-rich Willamette Basin in 2015.

This situation is paralleled around the world, and points toward a strong emerging area for growth in research, education, and outreach. Oregon State University recognized this as an opportunity and welcomed the first class of the joint Master of Science degree in Water Cooperation and Diplomacy from the University for Peace in Costa Rica, the IHE Delft Institute for Water Education in Delft, the Netherlands, and Oregon State University.

Oregon's Water Resources Research Institute, called the Institute for Water and Watersheds (IWW), coordinates interdisciplinary research, training, and technology transfer on issues related to water. The IWW program assists faculty in providing outreach and research related to water resources issues on an "as-requested" basis with a "use inspired" research focus. Partners and constituents include educational institutions, state and local governments, watershed councils, and the general public. While the IWW supports research through USGS funding, the new model for IWW supports grant preparation and the integration of undergraduate research.

The IWW is involved in promoting the effective and sustainable use of water resources in the State of Oregon. IWW serves as a hub for water resources activities, for example:

- IWW is part of the OSU's Graduate Water Resources Graduate Program (http://oregonstate.edu/gradwater/).
- IWW operates and maintains a water collaboratory as a teaching lab for students and faculty.
- IWW funds graduate student hydrologic events such as an annual water symposium and field trips.
- IWW staff serve as expert "volunteers" to state agency advisory committees, county water committees, local watershed councils, and citizen science committees.
- IWW initiates and coordinates transdisciplinary water resource research projects and through the
- USGS water institutes program,
- IWW sponsors a regional water resources seminar each spring term on topics such as drinking water, stream restoration, water quality, water economics, and water conflict. Speakers from Oregon, the United States, and abroad participate in the program which has a different focus topic each year.
- IWW assists faculty in managing complex research grants and contracts.

Research Program Introduction

Oregon State University is ideally positioned to assume a leadership role in addressing water problems, with about 125 faculty in six colleges who teach and conduct research in areas related to water and watersheds. OSU is renowned for its landscape-scale ecosystems research and continues to grow five graduate degree programs in Water Resources. These research and education efforts have all occurred without the benefit of programmatic coordination or strategic vision.

Oregon's Water Resources Research Institute, called the Institute for Water and Watersheds (IWW), coordinates transdisciplinary research, education, and technology transfer on issues related to water and water use. The IWW program focuses on statewide water resources issues by assisting faculty within Oregon State University, as well as those located within neighboring Portland State University, University of Oregon, Western Oregon University, Oregon Institute of Technology, among many community colleges located across the state, to provide outreach and research related to water resources issues on an "as-requested" basis with a focus on "use inspired" research. Partners and constituents of include educational institutions, state and local governments, watershed councils, and citizen scientists. While the IWW supports research through USGS funding, the model for IWW is to support grant preparation and integration of undergraduate students in the research enterprise.

The IWW is involved in promoting the effective and sustainable use of water resources in the State of Oregon. IWW serves as a hub for water resources activities, for example:

- IWW is part of the OSU's Graduate Water Resources Graduate Program (http://oregonstate.edu/gradwater/). ·
- IWW is part of OSU's Institute for Natural Resources.
- IWW staff serve as expert "volunteers" to state agency advisory committees, county water committees, and local watershed councils.
- IWW initiates and coordinates transdisciplinary water resource research projects and through the
- USGS water institutes program,
- IWW sponsors a regional water resources seminar each spring term on topics such as drinking water, stream restoration, water quality, water economics, and water conflict. Speakers from Oregon, the United States, and abroad participate in the program which has a different focus topic each year.

The IWW is the hub for this diverse water research community. It seeks to solve complex water issues by facilitating integrative water research. The IWW's functions are to:

- Assemble diverse research teams and lead interdisciplinary and transdisciplinary water research projects.
- Help policy makers and water managers collaborate with university faculty and students.
- Offer training and access to water quality and stable isotope analysis facilities through a shared laboratory called the IWW Collaboratory.
- Encourage community and collaboration among water faculty, students and water managers by sponsoring events and producing a monthly statewide water newsletter.
- Assist water faculty with project development and management.

Why Focus on Water?

Oregon's economic vitality is directly tied to water. Water is “virtually” embedded in all Oregon products, from timber and salmon to solar panels and semiconductors. But water supply and demand in the state is changing. There is now less snowpack in mountain regions and the snow is melting earlier in the spring and summer. These changes have implications for irrigation, human consumption, hydropower generation and ecosystems. Shifting population, land use patterns and environmental policies will also influence the future supply and demand for abundant clean water. And the state of Oregon is updating the Integrated Water Resources Strategy, one of two western states that was without a strategic water plan until 2012, to prepare for climate change and the wave of anticipated “climate change refugees” from drier and hotter regions of the United States.

Through an integrative research approach, the IWW seeks answers to questions important for Oregon, the nation and the world, such as:

- Where are climate change and human activity most likely to create conditions of water scarcity or an overabundance of water?
- Where is water scarcity or flooding most likely to exert the greatest impact on ecosystems and communities?
- What strategies would allow communities to prevent, mitigate, or adapt to scarcity and flooding most successfully?

Oregon State University hosts strong graduate degree programs in Water Resources and is located near state-of-the-art experimental watersheds and a suite of federal environmental laboratories. Below are short descriptions of some of the university's strengths in the areas of:

- water science
- water engineering
- water policy and management
- water diplomacy

Water Science

The OSU community has one of the largest gatherings of hydrologists and ecologists in the USA. They include not only campus faculty but also courtesy faculty from the suite of federal research laboratories located adjacent to campus, as well as state and federal agencies. This combination makes for a world-class grouping of people, mapped against one of the strongest hydrological gradients (from the super-humid Oregon Coast to extreme aridity in Eastern Oregon) in the world. The campus is known for its transdisciplinary collaborations -- for example, faculty from the top-ranked forestry and conservation biology programs collaborating on salmon conservation studies. Many researchers take advantage of nearby field laboratories such as the NSF Long Term Ecological Research (LTER) facilities at the HJ Andrews Experimental Forest and industry timberland instrumented watersheds in the Oregon Coast range (Hinkle Creek, Alsea and Trask).

The OSU-Benton County Green Stormwater Infrastructure Research (OGSIR) Facility, a three-celled stormwater research facility for field-scale experiments and testing on green infrastructure (e.g.,

raingardens, bioswales, etc.), was completed in 2014. Stormwater Solutions, a film highlighting the creation of the OSGIR can be viewed at the following link (https://media.oregonstate.edu/media/t/0_03knf8eg).

Faculty from Oregon State University, the University of Oregon and Portland State University completed the final year of work on a five-year project funded by the National Science Foundation titled "Willamette Water 2100," a study that used Oregon's Willamette River basin as a test case for managing regional water supply. This project evaluated how climate change, population growth, and economic growth will alter the availability and the use of water in the Willamette River Basin on a decadal to centennial timescale.

Water Engineering

Unlike other land-grant institutions, OSU's engineering connection gives it strengths in treatment technologies for surface water, groundwater, and wastewater systems. OSU Engineering now ranks in the top 50 programs in the US. Many OSU engineers specialize in biological treatment methods and OSU hosts a Subsurface Biosphere Initiative that emphasizes interdisciplinary research on soil and groundwater microbial ecology.

Many engineering faculty are also connected to the Oregon Built Environment & Sustainable Technologies Center (Oregon BEST) that connects the state's businesses with its shared network of university labs to transform green building and renewable energy research. Partnering with the OSU College of Business places a “business face” on the sustainability of engineered solutions to water problems.

Water Policy and Management

Addressing water resource challenges and reducing conflict in the US and abroad requires that water professionals and decision-makers receive specialized resources and skills that go beyond the traditional physical systems approach to water resources management. OSU offers a post-graduate certificate as part of their Program in Water Conflict Management and Transformation. The program leverages personnel from the top-10 nationally-ranked Geosciences Department, the top nationally ranked College of Forestry, as well as specialists in water policy, social science, communication, and anthropology. The “softer side” of OSU water has close links with UNESCO, the World Bank, the US Bureau of Reclamation and the US Army Corps of Engineers.

Joint Education Programme in Water Cooperation and Peace

UNESCO-IHE Institute for Water Education in the Netherlands, the University for Peace (UPEACE) in Costa Rica, and Oregon State University (OSU) in the USA, have embarked on a joint education program in Water Cooperation and Peace. The goal of this new initiative is to broaden the scope of approach to conflict and peace, provide a more theoretical dimension to conflict, engage multi-level scales of conflict dimensions and strengthen skills through highly experiential learning opportunities. The program will provide tools and training in an international setting, with a unique opportunity to undertake coursework and hands-on experiences in Costa Rica, The Netherlands and the United States. Participants will be exposed to case studies involving diverse challenges and contexts at different scales. The first student from the US has undertaken their studies in Costa Rica and the Netherlands and will finish their degree at OSU.

Supporting Near Real-time Reservoir Dynamics Monitoring with USGS Satellite Data

Jamon Van Den Hoek, Oregon State University

Office of Water Information WRRI Coordination Grant report June 2017

In the year since my last update, the research methodology employed for monitoring reservoir dynamics with USGS satellite data has evolved to take advantage of large volume environmental data accessibility and distributed processing opportunities afforded by the Google Earth Engine analytical framework and underlying cloud computing architecture. The research products have also evolved in response to pivotal developments around global- scale monitoring of surface water dynamics, principally the public release of the European Commission's Joint Research Centre's (JRC) data on location and temporal distribution of surface water from 1985 onward (Pekel et al., 2016). While JRC data are based on Landsat data time series, there are significant limitations in the use of these data for achieving temporally consistent monitoring of surface water dynamics. Indeed, the synoptic perspective offered by the JRC dataset is appropriate for long-term assessments of changes in surface water extent or frequency but has less value for sub-annual or seasonal dynamics. Such limitations are especially problematic for understanding the effects of drought, changing management practices, or precipitation variation on reservoir dynamics in persistently clouded regions or regions with other forms of missing data. In overcoming limitations, I have developed and implemented an approach for monitoring reservoir dynamics that a) leverages the full Landsat archive and available topographic and bathymetric data, and b) employs a unique spatial morphological approach that overcomes shortcomings associated with missing data to provide a more comprehensive understanding of short- and long-term reservoir dynamics.

Background

Reservoirs are critical global infrastructure for managing and mitigating the effects of climate change-driven shifts in precipitation and evaporation regimes. Reservoirs supply irrigation water for agriculture and freshwater for drinking as well as hydroelectric power generation (García et al., 2014; Vörösmarty & Sahagian, 2000), and recent research is showing the importance of reservoirs for influencing atmospheric carbon dynamics (Fearnside, 2005; Rudd et al., 1993; Tranvik et al., 2009). Remote sensing time series data offer the potential for systematic monitoring of reservoir dynamics at the global scale, ensuring broad spatial coverage as well as a deep historical data lineage. The advantages of a satellite image-based quantification of reservoir dynamics are especially pronounced for reservoirs located in geography remote or high-elevation regions, conditions which make consistent and long-term monitoring a challenge, or in regions where the cost of constructing or maintaining a hydrologic gauge network is prohibitively expensive. However, remote sensing measurements of reservoir dynamics in the tropics are complicated by persistent cloud cover over reservoir bodies (Fig. 1).

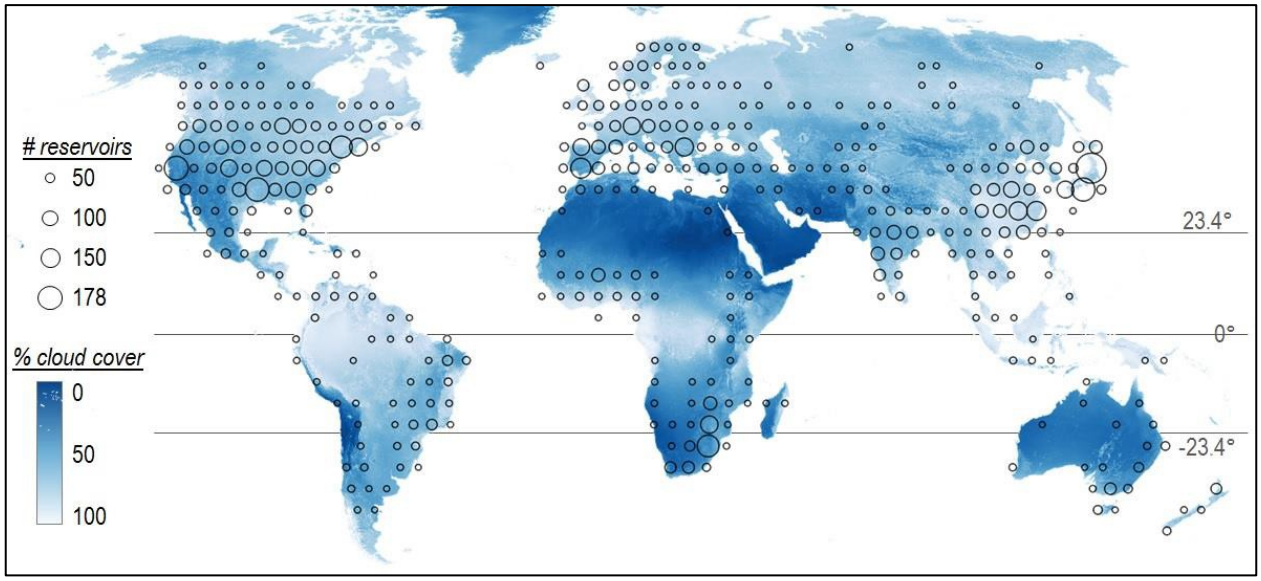


Figure 1. Approximately 15% (1,040) of the 6,824 GRanD reservoirs are located in the persistently clouded tropics (within ±23.4° latitude), which makes remote observation of reservoir dynamics especially difficult. Reservoir count is summarized within 5° square cells and cloud cover is depicted by percent daily cloud coverage from the MODIS MOD09GA product (2003-2014, 1km resolution).

Though the need for long-term, systematic reservoir monitoring is well understood, MODIS- based reservoir coverage products (e.g., the Global Lakes and Wetlands Database, the SRTM Water Body Dataset, the ESA CCI Global Land Cover Dataset, the Global Reservoir and Dam Database) only offer a single snapshot of reservoir surface area that is unfit for assessment of reservoir dynamics. While MODIS time series data have regularly been used to monitor reservoir dynamics at sub-monthly time scales (Gao et al., 2012; Zhang et al., 2014), the sensor's relatively coarse spatial resolution of 250m impedes quantification of surface area changes (e.g., Kang & Hong, 2016) with heightened consequences for monitoring reservoirs with shallow near-surface bathymetry (Smith & Pavelsky, 2009). With such spatially coarse measurements, and identification of dates of reservoir capacity minima and maxima that are relevant for assessing hydropower or irrigation potential and monitoring drought effects are also made difficult. The less than 20-year observational record of MODIS may be inadequate for longer-term reservoir dynamics associated with multi-stage water policy implementation, or decadal atmospheric carbon flux dynamics.

The 30m spatial resolution and over 40 years of global coverage at least every 16 days offered by the Landsat archive supports improved suitability for monitoring surface water(Donchyts et al., 2016; Feng et al., 2015; Mueller et al., 2016; Pekel et al., 2016). However, Landsat's revisit period means that atmospheric effects such as cloud cover or haze cannot be as readily mitigated as with 8- or 16-day MODIS temporal composites (Alsdorf et al., 2007. In addition, Landsat's swath width of 170km (8% of MODIS' 2300km swath width) necessitates mosaicking multiple near-date scenes to monitor reservoirs that span multiple scenes, and Landsat 7's Scan Line Corrector (SLC) Error eliminates 22% of otherwise viable pixels from each image collected since March 2003. Despite these challenges, the need for higher spatial resolution monitoring over longer periods has positioned Landsat and Landsat-like data from other sensors (e.g., Sentinel 2) as central datasets for remote sensing of reservoir dynamics.

Methods

To monitor reservoir dynamics in a timely, up-to-date, and fully historical perspective, I developed an inherently scalable and cloud cover-resilient satellite data-driven approach for long term monitoring of surface water area with high spatial accuracy. Using Google Earth Engine's javascript API, I developed a framework to build time series of surface area estimates for selected reservoirs using all available Landsat surface reflectance-corrected imagery collected since 1985. Since the water body mask in Landsat's CFmask product has high accuracy for surface water pixel detection, I simply derived binary surface water maps from the CFmask rather than generate a novel surface water dataset.

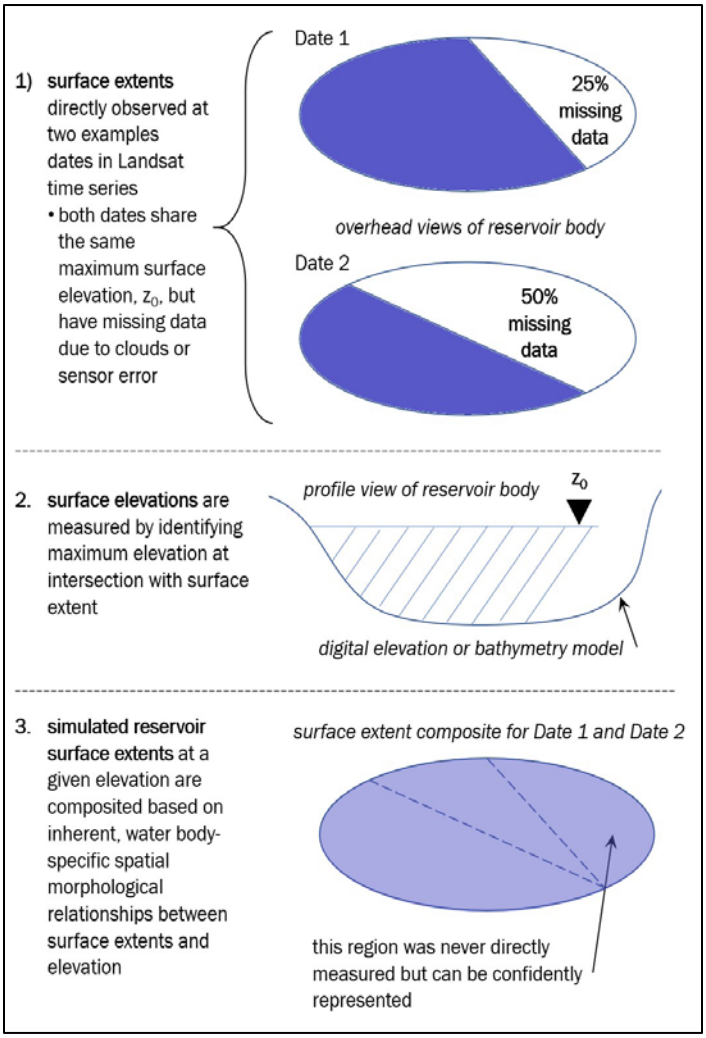


Figure 2. Overview of spatial morphology-based approach combining Landsat time series and digital elevation or bathymetry data to generate composite surface areas free of missing data. Only two example image-dates are shown though the implementation is applied for the full time series.

While my original (Python-based) algorithmic approach relied upon near-date temporal compositing to address cloud cover and other missing data, I instead developed a novel spatial morphological approach to constructing surface area time series data. This technique assumes that a given surface elevation is directly (low variation) and consistently (over time, spatial extents, and elevation values) related to a surface area for a selected reservoir regardless of volume, surface area, or elevation. Surface area measurements are, of course, often obscured by atmospheric effects or Landsat 7's Scan Line Corrector error. However, since the surface elevation at the reservoir's extent will be consistent around the reservoir's boundary, this topographic/bathymetric isoline marks out the reservoir's extent as well. In cataloguing surface elevation values across all dates and cross-referencing these elevations values with corresponding surface area extents, missing data from any image date can be mitigated by referencing like-elevation dates (Fig. 2).

Lake Mead presents an ideal case study for the development and assessment of this approach for several reasons. First, because of the well documented and extensive depletion of reservoir volume, the Lake Mead reservoir displays extreme variation in surface area and elevation. Second, the high resolution (10m lateral) digital bathymetric model of Lake Mead produced by the USGS using sidescan-sonar and high-resolution seismic- reflection data (https://data.doi.gov/dataset/surface-representing-the-floor-of-lake-mead-and-the-surrounding-area-utm-projection-10m-cellsiz) supports measurement of the reservoir's full elevational profile across seasons and years (Fig. 3). Third, and relatedly, there are additional digital topography/bathymetry models with coverage surrounding Lake Mead (e.g., the Shuttle Radar Topography Mission's (SRTM) with 30m lateral resolution, and the USGS' National Elevation Dataset (NED) with 1/3 arc-second lateral resolution). SRTM and NED are less useful since they adopt a 'typical' and constant surface elevation value for the minimum observable elevation, overlooking the elevational variation below the surface as represented that the USGS dataset provides. That said, these datasets are representative of the elevational data provided across the United States and globally, and are thus important to include for assessing the proposed method's relevance for reservoirs without available detailed bathymetry. Fourth, and finally, while Lake Mead does not present significant cloud cover, the data gaps resulting from Landsat 7's SLC off error (2003- present) must be addressed for historical, global monitoring of reservoir dynamics, and *can* be with the developed method.

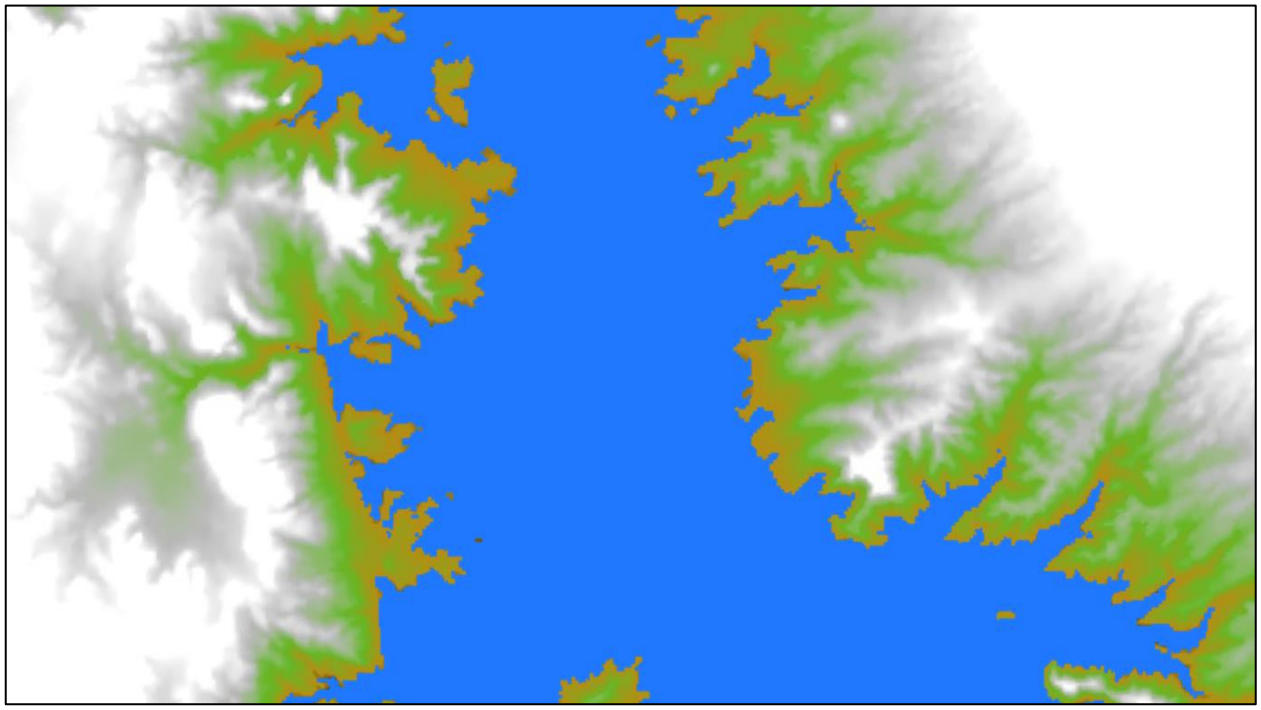


Figure 3. A snapshot of the Lake Mead reservoir surface area (blue) as detected by Landsat 8 in March 2013 with the digital bathymetric model (orange-green-grey-white) represented in the background. As is evident, the outermost extent of surface water occupies a rather consistent elevation value.

Peer-review article preparation and submission

The Google Earth Engine-based analytical approach has been successfully tested with the full Landsat 8 time series (2013-present) of 260 images (as of May 26, 2017) spanning two Landsat path-row scenes, 38-35 and 39-35. A table of wholly remote sensing-derived Lake Mead-specific relationships of surface elevation-extent values over these 260 observation dates has been generated. Immediate next steps in June 2017 is the completion of similar table generation for Landsat 5 (2000-2011) and Landsat 7 (2000-2017) time series data of 711 and 1,117 images, respectively. With these data completing the full 2000-2017 time series, I will generate surface area-elevation plots, plot the remote sensing-derived Lake Mead surface area time series, measure volumetric dynamics following Eqn. 1, and, finally, compare measured surface elevation and volumetric time series to *in situ* data; *in situ* surface area data for comparison are not available. Python code for each of these latter analyses has been written and successfully demonstrated. Finally, the utility of the method will be evaluated with respect to available very high resolution bathymetric, high resolution topographic, and moderate resolution topographic elevation model data, which will inform the potential applications of the method across a representative range of elevation data availability scenarios.

By the end of Summer 2017, my colleagues at USGS CIDA and I will submit a Lake Mead- focused manuscript to either *Limnology and Oceanography: Methods* or *Remote Sensing* with 2015 Impact Factors of 2.008 and 3.036, respectively. Following this submission, we will extend the methodological application to a sample of three persistently clouded tropical reservoirs.

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Information Transfer Program Introduction

OSU's reputation for providing vital environmental information to students and the public is beyond reproach. A few of OSU's water-related outreach programs include:

- The Oregon Well Water Program - An OSU Extension program designed to help Oregonians protect the groundwater that supplies their drinking water through education.
- The Oregon Explorer Program - An online digital library that provides natural resources information to decision makers through a growing series of Web portals.
- Oregon Digital Water Atlas - an incredible amount of datasets and hydrologic data exists on state and federal agency websites, yet little of these data have been captured and depicted in a consistent format. The Oregon Digital Water Atlas was completed this year and can be viewed at oregonwater.info

Acknowledging that academics need to communicate research in different ways with policymakers, IWW has experimented with new ways to diversify our outputs. Gone are the days of simply sending academic journal articles to policy makers and staff. IWW now completes what is termed "just-in-time" white papers or short You-Tube videos on topics of interest, promoting the notion that IWW's research is indeed "use inspired".

Other Collaborative Activities

The IWW Collaboratory was moved to a new location due to building demolition. Despite the relocation of the lab, the lab continued to process samples, the number of users (departments, entities) continues to increase and totals over 43.

The 6th Annual OSU Student Water Research Symposium put on by the Hydrophiles and the Water Resources Graduate Program and sponsored by IWW had over 135 attendees from 6 universities with 10 professional mentors over a two day period.

The IWW continues to be a teaching and technical resource for the Environmental Conflict Resolution courses at the University of Oregon Law School located in Eugene, OR.

IWW Collaboratory

The IWW Collaboratory offers training and access to water quality facilities through a shared laboratory.

The Collaboratory was forced to relocate to a new location due to a building demolition and reconstruction. As a consequence, the annual number of analyses decreased by nearly 50% to approximately 10,000 samples, the number users remained at approximately 45, but the new users increased, most focusing on Public Health and Human Development & Family Sciences.

Part of the USGS 104(b) funds were used to purchase a new Deionized (DI) water system for the laboratory. Water derived from the new DI system is used in many other analytical laboratories across the OSU campus.

Summer Internship Program Introduction

Basic Information

Start Date:	5/1/2016
End Date:	5/10/2017
Sponsor:	US Geological Survey
Mentors:	Todd Jarvis
Students:	Maoya Bassiouni

Internship Evaluation

Question	Score
Utilization of your knowledge and experience	Acceptable
Technical interaction with USGS scientists	Acceptable
Treatment by USGS as member of a team	Acceptable
Exposure and access to scientific equipment	Acceptable
Learning Experience	Acceptable
Travel	About Right
Field Experience Provided	About Right
Overall Rating	A

Additional Remarks

Publication

Bassiouni, M. and Scholl, M.A., in press, A Method for Quantifying Cloud Immersion in a Tropical Mountain Forest Using Time-Lapse Photography, Agricultural and Forest Meteorology AGRFORMET-D-16-00971.

The links associated with the final products from this project

- paper: http://www.sciencedirect.com/science/article/pii/S0168192317301442
- data release: https://www.sciencebase.gov/catalog/item/58ffa40ae4b0e85db3a46c40

Student Support

Student Support					
Category	Section 104 Base Grant	Section 104 NCGP Award	NIWR-USGS Internship	Supplemental Awards	Total
Undergraduate	3	0	0	0	3
Masters	1	0	0	0	1
Ph.D.	1	0	1	0	2
Post-Doc.	0	0	0	0	0
Total	5	0	1	0	6