The Water Report™
Water Rights, Water Quality & Water Solutions in the West

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Upcoming Stories:

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Ambos-Nogales Effluent Framework

Klamath Hydro Settlement

& More!

BASIN-WIDE WATER COLLABORATION

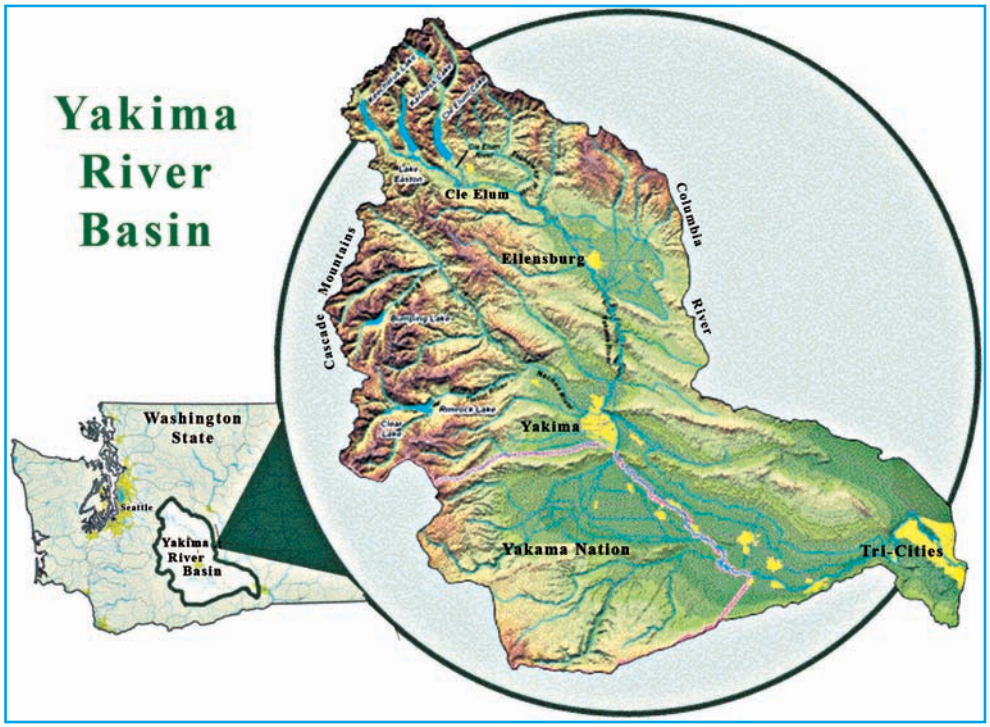
THE YAKIMA BASIN INTEGRATED PLAN AT 10 YEARS
FROM INSPIRATION TO IMPLEMENTATION

by Steve Malloch, Western Water Futures, LLC (Seattle, WA)

Introduction

Washington's Yakima Basin Integrated Plan (YBIP) is an innovative initiative applying collaborative and integrated approaches to solving classic Western water problems. Concentrated in one basin are the thorny issues of: drought; climate change; maintaining a robust agricultural economy; Tribal rights; and fishery restoration. The YBIP process began in 2008, with implementation commencing in 2013. The initiative succeeded in both developing a plan and building unusually broad stakeholder support, which caused it to be hailed as a model for making progress on Western water issues. The question now is whether YBIP is delivering on results.

This article focuses on current events for YBIP to provide an assessment of results to date. Many of these recent events are successes — building on the foundation of collaborative problem-solving that puts to one side ideology, philosophy, and long-entrenched positions. But getting to yes in a collaborative process is the start of the work, not the end. Implementation is every bit as tough and raises its own set of thorny issues. To the extent that YBIP may serve as a model for resolving conflict in other basins, one lesson is that the need for hard work, leadership, and problem-solving does not stop with agreement on a plan.



Yakima Basin Plan

Acquavella

Conflict

Agriculture & Recreation

Fishing

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260 North Polk Street,
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Editors: David Light
David Moon

Phone: 541/ 343-8504
Cellular: 541/ 517-5608
Fax: 541/ 683-8279
email:
thewaterreport@yahoo.com
website:
www.TheWaterReport.com

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Recent highlights include: federal legislation authorizing the Initial Development Phase of YBIP; construction of the first water supply project for fisheries; construction in progress of the first major fish passage project; environmental review of a major water supply project; progress on water conservation; and an innovative fish flow project led by an irrigation district. All of which suggest an answer of "results are being delivered and more is on the way."

Relevant, but not addressed in this article, is the Final Decree issued on May 9, 2019, ending the 42-year general stream adjudication in *Ecology v. Acquavella*. *Acquavella* is an epic saga deserving its own chronicle. Sorting out the surface water rights in the basin was unquestionably a foundation for reaching agreement on broader water and fishery issues. (For background on *Acquavella see* https://ecology.wa.gov/Water-Shorelines/Water-supply/Water-rights/Adjudications/Ecology-v-Acquavella).

Background

Prior aricles in The Water Report on YBIP provided an overview (*The Water Report* #106); an opponents' view and proponents' response (*TWR* #108); and two perspectives on an economic analysis (*TWR* #135).

Setting

Washington's Yakima River Basin supports a vibrant agricultural and recreational economy and is the historic home to important salmon and steelhead populations. All of these benefits depend on cool, clean, abundant, and reliable water supplies. Water is a source of conflict — decades of litigation and political wrangling created deep divisions in the basin, resulting in stalemate for improvement of water supply reliability, slow progress on restoring fish runs, and extremely contentious relations among stakeholders.

Agriculture is big business in the Yakima River Basin, worth about $4.5 billion per year with exports of more than $1 billion per year. Eighty percent of the nation's hops are grown here, along with grapes (both wine and juice), hay, and tree fruit. The recreational economy is big as well — $1.2 billion. In the basin, more than 96,000 jobs depend on water. ECONorthwest. *Water Security for the Yakima River Basin's Economy, Communities, and Watersheds*. Washington Department of Ecology (Ecology), 2017 (Publication No. 17-12-010).

Salmon and steelhead once returned to the Yakima River Basin in huge numbers, making the Yakima River the second largest tributary run on the Columbia River. Development of the basin — including the five major storage reservoirs the US Bureau of Reclamation (Reclamation) built without with fish passage — caused a precipitous decline in salmon populations. A robust fishery that produced over 800,000 salmon per year declined by the mid-1990's to only a few thousand steelhead, spring chinook, and fall chinook. Runs of sockeye, coho and summer chinook were extirpated. Steelhead and bull trout are now listed as threatened under the federal Endangered Species Act (ESA). In order to bring salmon back, fish passage at the Reclamation dams, extensive habitat restoration, and stream flows supporting fish are needed. The Yakama Nation has a right under an 1855 Treaty with the United States to hunt and fish in their usual and accustomed places, but without enough fish in the system, that right cannot be meaningfully exercised.

Hydrology and Climate Change

While the five Reclamation reservoirs supply water for irrigating 450,000 acres of agricultural crops, those reservoirs provide only about 1.1 **m**illion **a**cre-**f**eet (MAF) of storage in a basin with water rights totaling approximately 2.4 MAF and annual flow averaging 3.3 MAF. The basin relies on 1 to 1.5 MAF of snowpack in the Cascade Mountains to store winter precipitation that slowly melts in the spring and summer, providing water supplies when it is needed most.

While there have always been years with low precipitation, 2015 heralded a new kind of drought — one with normal precipitation but a warm winter, where instead of snow, rain fell. This is consistent with climate model prediction for this basin, which suggests small changes to overall precipitation, but a strong shift from snow to rain. From a climate perspective, 2015 may be the new normal for the future. Given modest reservoir storage, this means that the Yakima River Basin needs to find additional means of water storage to maintain existing agriculture and to provide flows for restored fisheries.

Prior Legislation

Since a serious drought in 1977, the federal government, Washington state, the Yakama Nation and the irrigation districts have worked on improving water supply reliability through conservation and efficiency, as well as fishery restoration. Congress passed legislation authorizing Reclamation's Yakima River Basin Water Enhancement Program (YRBWEP) in two phases of federal work: first on fish passage and screens in 1979 (P.L.96-162 - authorizing a feasibility study of what turned into YRBWEP) and 1984 (P.L. 98-381§109 - authorizing fish passage in the basin, referred to as YRBWEP I). YRBWEP II on water conservation improvements was passed in 1994 (P.L. 103-434, Title XII, §§ 1201-1210, as amended by P.L.105-62 and P.L.106-372). New storage was anticipated as an eventual YRBWEP III.

These, and other, pieces of federal legislation authorized many of the projects that are included in YBIP — projects authorized but not undertaken or completed for various reasons. For instance, fish passage

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Yakima Basin Plan

Looming Crisis

was authorized for the five major Reclamation storage reservoirs in 1984 but never funded or constructed until the political breakthrough of YBIP. Work on conservation and efficiency under YRBWEP II is a continuing effort, slowed by the general stream adjudication; as water rights became more certain, interest in conservation projects increased.

YBIP Development

By the mid-2000's the basin was in looming crisis. Fishery restoration was being undertaken but could not reach the needed scale without passage at the federal reservoirs. New storage was stalled. Water conservation and efficiency projects were being built, but slowly. No set of interests could move forward on solutions without other interests blocking them. A new approach was needed.

In 2008, leaders in the Yakima River Basin from irrigation districts, the Yakama Nation, government at all levels, and the community began working together to develop the Yakima Basin Integrated Plan. In 2012, a final programmatic Environmental Impact Statement (EIS) laid out the 30-year Yakima Basin Integrated Plan. (*Yakima River Basin Integrated Plan Final Programmatic Environmental Impact Statement*, Reclamation Ecology, March 2012. Available at: www.usbr.gov/pn/programs/yrbwep/reports/FPEIS/fpeis.pdf).

Seven Elements Identified

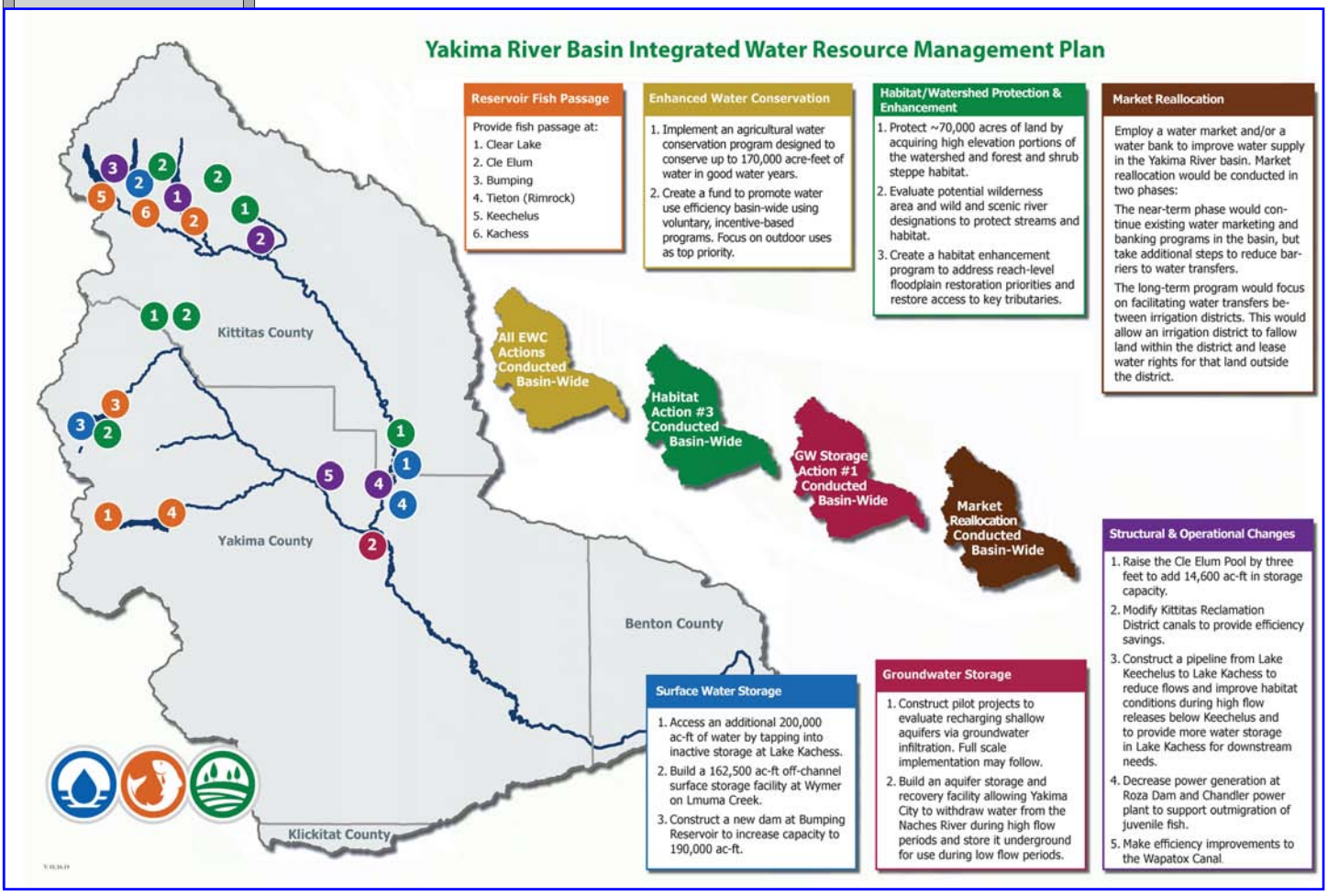
YBIP identifies seven elements necessary to address to achieve a balanced and comprehensive approach to water resources management and ecosystem restoration in the Yakima River Basin. Working in concert, the high-level goals of the projects under these seven elements are:

Water Supply

- Provide reliable water supplies to agriculture and cities even during serious drought. The goal is to increase modestly municipal and domestic supplies, and to provide 70% water supplies to Reclamation contractors during significant drought through improving the use of water and existing infrastructure, as well as building new surface and groundwater storage.

Fish & Wildlife

- Enhance fish and wildlife populations and habitat, and recover and maintain self-sustaining harvestable populations of anadromous and resident fish and aquatic life throughout their historical distribution range in the Yakima River basin. The goal is to restore self-sustaining populations of salmon and steelhead in the hundreds of thousands. This involves improving habitat, providing instream flows for fish, and gaining access to habitat blocked by Reclamation dams and other barriers.



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Yakima Basin Plan

Three Phases

YBIP will be implemented in three phases, each about a decade long. Each phase is designed to move each of the seven elements forward, with every phase including a major surface water supply project and a fish passage project. The political agreement was to move forward with an Initial Development Phase (IDP) including the most achievable projects. More complex projects such as new or greatly expanded reservoir storage were deferred to the later YBIP phases.

Authorization

State and Federal Authorization of YBIP

YBIP is a compilation of a programs and projects, some purely state, some purely federal, some local or Tribal, and some a combination. Further, while many of these programs and projects already had state or federal authorization, others required new state or federal authorization.

State authorization for YBIP came quickly, with policy legislation and initial funding in 2013 (2SSB 5367. Available at: http://lawfilesext.leg.wa.gov/biennium/2013-14/Pdf/Bills/Session%20Laws/Senate/5367-S2.SL.pdf#page=1).

Federal "Ask"

Gaining federal authorization for the Initial Development Phase took much longer. The process began in 2012 with Reclamation identifying existing authorities for YBIP in a letter from Reclamation Commissioner Michael Connor to Representative Doc Hastings, dated September 21, 2012 (available upon request). Senator Maria Cantwell's attention was gained when a group of state, Tribal, irrigation district, and conservation NGO stakeholders walked in her office with a unified ask — rather than the open hostility which might have been expected. Senator Cantwell and Congressional staff worked closely with YBIP stakeholders and Reclamation to draft YBIP-specific legislation.

Political Headwinds

In the House, authorizing YBIP was considered a "prohibited earmark" and a different approach was taken. Representative Dan Newhouse, a strong supporter of YBIP, attempted programmatic authorization of Reclamation water projects — a tack that ran into political headwinds. The approaches of the two chambers of Congress proved to be incompatible until the change in political control of the House. Yakima language based on the Senate version was incorporated as a subtitle in P.L.116-9 — "The John D. Dingell, Jr. Conservation, Management, and Recreation Act" — signed into law on March 12, 2019. Achieving federal authorization for YBIP was a struggle, rewarded when persistence and being prepared for a political opening allowed passage.

Significant Yakima provisions of P.L.116-9 include:

Identifying Projects

Federal Authorization of YBIP: P.L.116-9 lays out the three YBIP phases and authorizes the federal elements of the IDP as well as a process for developing a subsequent Intermediate Development Phase and Final Development Phase. Collectively, the federal elements of YBIP are Phase III of YRBWEP. While there is a set of projects and programs identified as the IDP, there was no federal document which formally adopted the federal elements of the IDP to refer to in the legislation. To address this, the Secretary of the Interior, in coordination with the State of Washington and the Yakama Nation, shall "identify and implement projects under the Integrated Plan that are prepared to be commenced during the 10-year period" commencing upon enactment (P.L.116-9 §8201(b)(1)(A)). Nor have the projects of the Intermediate or Final Development Phases yet been identified, so for each of these subsequent phases, the Secretary will again identify projects ready for commencement (P.L.116-9 §8201(b)(2)). However, unlike the Initial Development Phase projects, these subsequent phase projects are not authorized, and will require subsequent Congressional action. All projects must meet the usual requirements of authorization and appropriation and are subject to environmental and financial review; in addition, the Secretary is required to determine that "a proposed project or activity is in the best interest of the public." P.L.116-9 §8201(b)(3).

Authorization & Appropriation

Inactive Storage Use

Kachess Drought Relief Pumping Plant (KDRPP): KDRPP is the first major drought relief water supply for agriculture in YBIP. The project involves a pumping plant that allows up to 200,000 **a**cre-**f**eet (AF) of water to be pumped from inactive storage in Lake Kachess during state declared droughts.

District Financing

P.L.116-9 §8201(c) authorizes construction of KDRPP but requires compliance with the National Environmental Policy Act (NEPA) and the ESA, which is still in process (*see* below). Recognizing that the federal government now rarely builds Reclamation irrigation water supply projects, the irrigation districts benefiting from the project are authorized to finance, construct, and operate KDRPP (P.L.116-9 §8201(c)(1)(A)). Irrigation district financing of KDRPP was essential in gaining support of Congress and the conservation organization stakeholders. KDRPP will be a part of Reclamation's Yakima Project, and subject to federal ownership and law. Water from KDRPP is Yakima Project water, but its use is limited to times when Reclamation's proratable irrigation districts receive less than a 70% supply (P.L.116-9 §8201(c)(2)(A)). (Note: Water rights associated with the Bureau of Reclamation's claim of all

Proratable Rights

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unappropriated surface water in 1905 are known as "proratable" and share equally in any shortage. Of the irrigation districts with Reclamation derived rights, Roza Irrigation District and Kittitas Reclamation District have only proratable surface water rights. Other irrigation districts have a mix of senior (pre-1905) and proratable surface rights).

Conservation Targets

Water Conservation: Under YRBWEP II, water conservation was focused on the mid- and lower Yakima River because of conservation opportunity and, at the time, salmon restoration potential was considered greatest there. Now the upper basin is considered to have the best salmon restoration potential; however, the YRBWEP II water conservation programs do not apply. P.L. 116-9 expands existing water conservation authority, modifying the existing YRBWEP II program and extending conservation projects into the upper basin. It adds a new water conservation target of 85,000 AF of conservation for the IDP to the YRBWEP II 165,000 AF target for the lower basin. *See* P.L.116-9 §8201(g), §8202(a)(7), §8203.

Aquifer Storage

Canal Use

Groundwater: Short- and long-term storage of water in aquifers appears promising in the Yakima Basin. Pilot projects and studies of storing water in shallow and deep aquifers are in process. Given Reclamation's control of the water infrastructure of the basin, explicit federal direction was needed to resolve issues of Reclamation's authority to use its canals for these projects. P.L.116-9 §8201(d) authorizes Reclamation to support groundwater recharge and aquifer storage and recovery projects, including permitting use of excess capacity in canals.

Climate Disruption Purpose

Expansion of Project Purposes: Reclamation's Yakima Project purposes were significantly expanded and focused by P.L 116-9 in notable ways. A new purpose is directed squarely at the challenges of climate disruption, without using the term "climate change:"

> To improve the resilience of the ecosystems, economies, and communities in the Yakima River basin facing drought, hydrologic changes, and other related changes and variability in natural and human systems, for the benefit of the people, fish, and wildlife of the region.

P.L.116-9 §8202(a)(11).

Fish & Wildlife Purpose

Prior legislation had added fish and wildlife as a project purpose, but without guidance for how Reclamation was to interpret that imprecise language. New language provides a much more ambitious and focused purpose aligned with YBIP, one that should help guide Reclamation's management of the Yakima Project consistent with YBIP goals:

F&W Goals

> To protect, mitigate, and enhance fish and wildlife and the recovery and maintenance of self-sustaining harvestable populations of fish and other aquatic life, both anadromous and resident species, throughout their historic distribution range in the Yakima Basin through—
> (A) improved water management and the constructions of fish passage at storage and diversion dams, as authorized under the Hoover Power Plant Act of 1984 (43 U.S.C. 619 et seq.);
> (B) improved instream flows and water supplies;
> (C) improved water quality, watershed, and ecosystem function;
> (D) protection, creation, and enhancement of wetlands; and
> (E) other appropriate means of habitat improvement.

P.L.116-9 §8202(a)(1).

Tribal Projects Maintenance

Indian Irrigation Projects: The largest set of senior and proratable Reclamation water rights in the basin is in the Bureau of Indian Affair's Wapato Irrigation Project (WIP) located on the Yakama Nation Reservation. WIP is in dire need of maintenance and updating. It has been the subject of several US Government Accountability Office (GAO) reports on maintenance, most recently in 2015, which found it to have the greatest backlog of deferred maintenance of any BIA irrigation project, then estimated at $138 million, or about 10% of the replacement value of $1.37 billion. (*See* Statement of Anne-Marie Fennell, Director, Natural Resources and Environment GAO, before Committee on Indian Affairs, U.S. Senate, March 4, 2015, *INDIAN IRRIGATION PROJECTS: Deferred Maintenance and Financial Sustainability Issues Remain Unresolved*, GAO 453-T).

Yakama Priorities

The Yakama Nation is in final stages of setting priorities for WIP maintenance and updating, with projects benefiting both irrigation and fisheries. P.L.116-9 §8201(h) authorizes up to $75 million in improvements to Pacific Northwest Indian irrigation projects, including WIP.

Federal authorization of YBIP accomplished exactly what was needed, no more and no less: endorsement of YBIP as a whole; authorization of the IDP consistent with the goals of the stakeholders, without larger controversial policy initiatives; and modification of the existing YRBWEP program. Passage took longer than expected for a project with bipartisan support but succeeded in the end.

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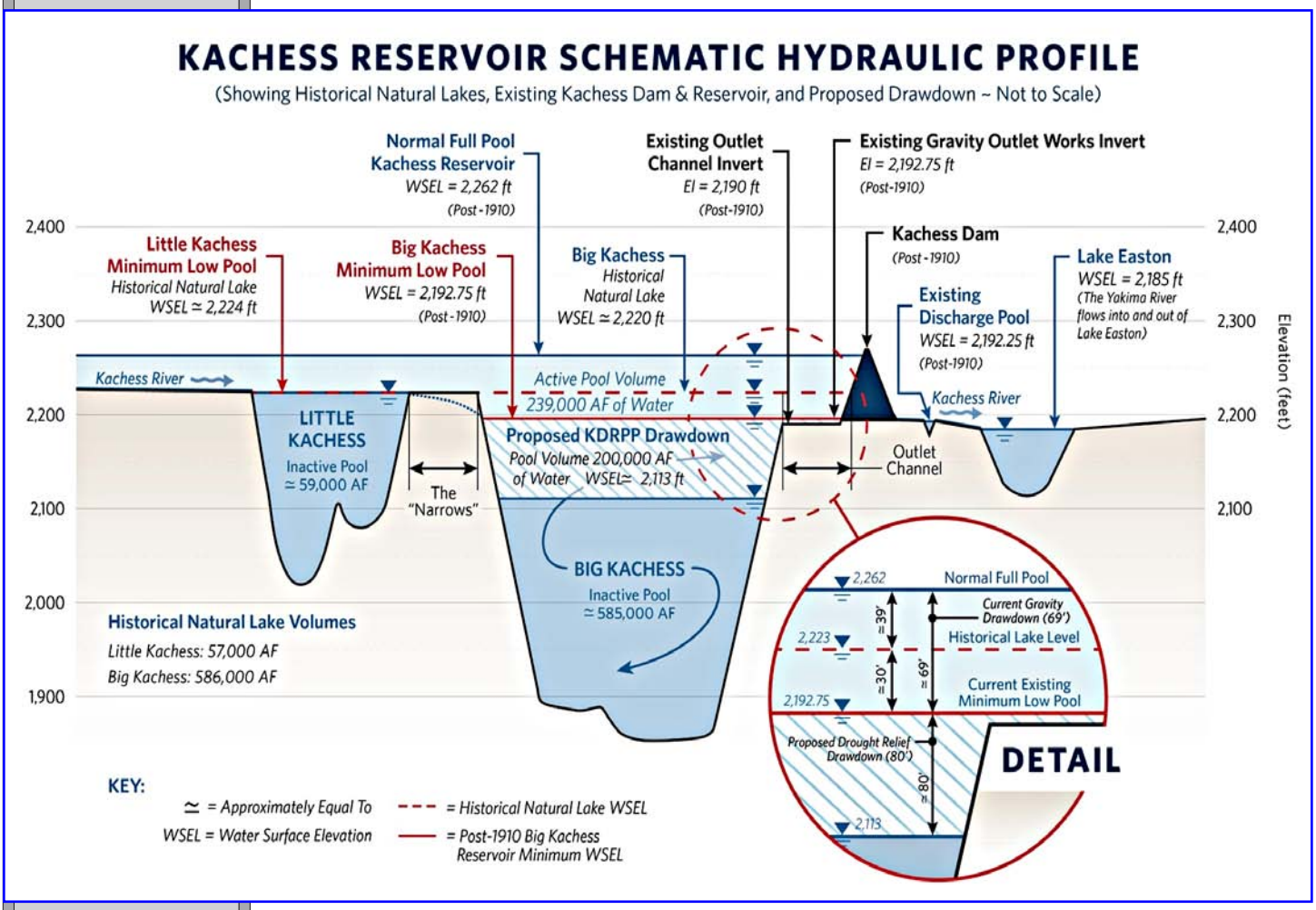
Yakima Basin Plan

Drought Relief

Kachess Drought Relief Pumping Plant EIS

The proposed KDRPP would draw upon water already stored at an existing lake and reservoir during a serious drought. Under P.L. 116-9 it would not be used to supply water during ordinary or even moderately dry years. The water KDRPP taps is like a family's savings account — set aside to be drawn down in bad years and refilled during good years. Using this water does not guarantee irrigators a full supply but does provide partial relief to otherwise devastating drought impacts on orchards and crops. If there are a series of dry years, Lake Kachess may take up to five years to fully refill — just like a savings account after a family emergency.



Inactive Storage Use

Kachess Dam impounds water on top of two natural lakes. Of the existing 883,000 AF of water in storage at Kachess, about 293,000 AF is in active storage and can be accessed to meet water supply demands using existing infrastructure. KDRPP would allow drawing upon up to 200,000 AF of water from the larger natural lake and not affect the other lake during significant droughts. Even when fully drawn down by KDRPP, 385,000 AF of water up to 250 feet deep would remain in storage in the larger natural lake. About four square miles of water surface would remain for recreation. There would be a large "bathtub ring" around the reservoir, but ordinary irrigation operations of the reservoir pool at Kachess leaves such a ring without KDRPP.

Initial EIS

Review of KDRPP has been protracted. A joint NEPA/State Environmental Policy Act (SEPA) draft EIS was issued in January 2015, evaluating both an on-shore pumping plant for KDRPP and a pipeline between Lake Keechelus and Lake Kachess intended to speed refill of Kachess after drawdown by KDRPP. (*See: Keechelus-to-Kachess Conveyance and Kachess Drought Relief Pumping Plant Draft Environmental Impact Statement*, Reclamation and Ecology, January 2015. Available at: www.usbr.gov/pn/programs/eis/kkc/kkcdeis.pdf). KDRPP alone was projected to cost more than $400 million, with benefits of only $215-$317 million.

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Yakima Basin Plan

Floating Pumping Self-Finance

Trump Order Complications

Solution: Two Tiers

Record of Decision

Lake Level Issues

Existing Storage

The severe drought of 2015 followed, during which Roza Irrigation District, one of the principal beneficiaries of KDRPP, considered installing a floating pumping plant to draw on Kachess as an emergency supply. Roza rejected doing so but realized that constructing a permanent floating plant could cost less than $200 million, making KDRPP attractive from its perspective. At that point, Roza offered to finance, construct, and operate the project, in collaboration with other eligible Reclamation irrigation districts that wanted to participate. The offer to self-finance and construct the project was the breakthrough that allowed planning to go forward. However, this floating plant concept required additional engineering, technical analysis, and ultimately a **s**upplemental **d**raft EIS (SDEIS).

Supplemental/Tier-1 Final EIS

Completing a new SDEIS was complicated by the Trump Administration issuing a 2017 Executive Order requiring streamlined NEPA compliance (*Establishing Discipline and Accountability in the Environmental Review and Permitting Process for Infrastructure Projects*, Executive Order 13807, August 15, 2017. Available at: www.usbr.gov/recman/temporary_releases/envtrmr-121-AppA.pdf). The Secretary of the Interior issued an order limiting NEPA documents to 150 pages plus appendices and required completion within a year of a Notice of Intent to prepare an EIS.

The Kachess SDEIS was not going to be complete within the time deadline for projects in process and so would be subject to the 150-page/one-year requirements — a severe problem for the already lengthy document and process. Compliance with the ESA was one source of delay in completing the environmental review process; to date, Biological Opinions are in process but have not been completed for either of the two directly affected listed species: steelhead and bull trout.

Reclamation's solution was to issue an SDEIS in April 2018 that stated it was a Tier-1 document and that a subsequent Tier-2 EIS would follow that would engage in "site-specific" analysis for selected alternatives. (*Kachess Drought Relief Pumping Plant and Keechelus Reservoir-to-Kachess Reservoir Conveyance,* SDEIS, Reclamation and Ecology, April 2018. Available at: www.usbr.gov/pn/programs/eis/kkc/kprojectsdeis2018.pdf). It issued the Tier-1 final EIS in March 2019 and Record of Decision (ROD) in April 2019 (*see respectively: Kachess Drought Relief Pumping Plant and Keechelus Reservoir to Kachess Reservoir Conveyance*, FEIS, Reclamation and Ecology, March 2019 — www.usbr.gov/pn/programs/eis/kdrpp/index.html; and *Record of Decision for the Kachess Drought Relief Pumping Plant and Keechelus Reservoir-to-Kachess Reservoir Conveyance*, FEIS, Reclamation and Ecology — www.usbr.gov/pn/programs/eis/kdrpp/feis2019/rod.pdf).

The ROD selected the floating pumping plant for continued analysis and dropped the Keechelus to Kachess pipeline because it failed to provide enough benefit. In the fall of 2019, Reclamation is expected to issue a Notice of Intent to begin the Tier-2 analysis that will be subject to the time and length limitations.

Opposition

Kachess Lake and Reservoir is located near I-90, just over Snoqualmie Pass from Seattle. Mountain homes, some secondary, some primary, line the lake. For many of the people who live and recreate at Kachess, the prospect of the lake level dropping during drought and the recovery period is not appealing. They have raised a number of issues: the need for the project; alternatives already in YBIP such as conservation and water marketing; the prospect of groundwater levels and wells being affected; recreational impacts; access to fire suppression water; effects on ESA-listed bull trout; reduced property values; and more.

Building new water storage in the West is almost always contentious and typically involves impacts. Generally, the conservation and water policy community urges making best use of existing supplies through conservation, efficiency, water transfers and system improvements, while also restoring the environment, before embarking on storage expansion. The approach taken in YBIP is "yes and" — make best use of existing supplies, restore fisheries and develop this new KDRPP storage by accessing water already in storage. The already apparent impacts of climate change and prospect of drought make the approach of YBIP compelling — that is to proceed on parallel tracks to make improvements in the entire system.

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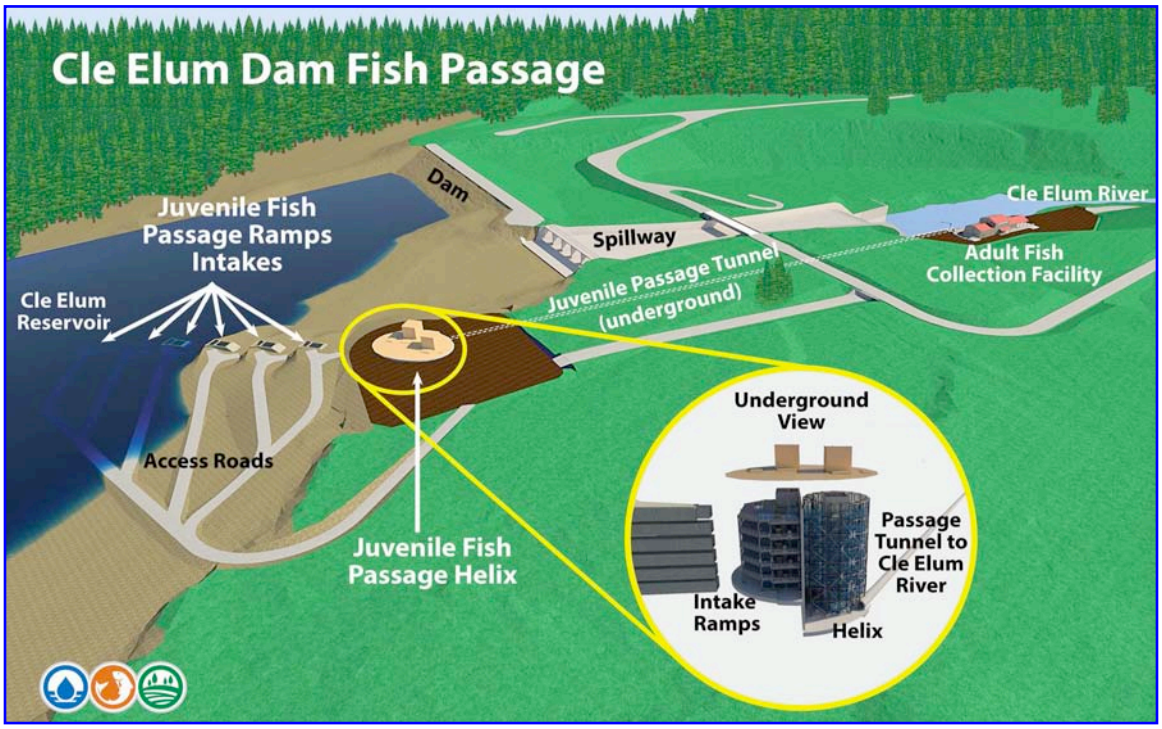
Yakima Basin Plan

Water Supply

Cle Elum Reservoir Projects

Cle Elum Reservoir is the focus of several of the IDP projects. It is the site for the first new Reclamation surface water supply in the basin in 80 years, and the first fish passage project at a large Yakima Project reservoir.



Level Raise

Cle Elum Pool Raise

In 1994, YRBWEP II authorized raising the level of the Cle Elum Reservoir by three feet, with water from the 14,600 AF of additional storage dedicated to fishery use, but constructing the pool raise project stalled. Under YBIP, Reclamation completed raising the level of the radial gates and modifying saddle dikes at Cle Elum Reservoir in 2018. However, the additional storage capacity cannot be used until shoreline protection measures are in place to protect banks from eroding. Reclamation anticipates completing the shoreline protection measures in three to five years, depending on availability of federal funds.

Habitat Access

Cle Elum Fish Passage

Some of the best salmon and steelhead habitat in the Yakima basin lies above the five major Reclamation dams, all of which were built without fish passage. For instance, there is about 30 miles of high elevation, cold water salmon and steelhead habitat above Cle Elum Reservoir, most of which is on National Forest land. Gaining access to that high elevation habitat is a priority for YBIP.

While fish passage at the Reclamation dams was authorized in 1984, Reclamation did not undertake construction until YBIP. In large part this was a political problem, addressed by the Yakama Nation through reintroducing sockeye salmon into Cle Elum in 2009 with an approach of "if they come, you will build it."

Fish Migration Design Challenge

However, there was a technical element as well. Juvenile passage at water supply reservoirs is complicated by water levels varying greatly. Smolts travel in the upper few feet of water. If reservoir levels are high, flows over the dam's spillway can flush smolts out. Floating collection systems combined with trap and haul exist; however, for Cle Elum a voluntary, continuous, outmigration system was needed. This presented a significant design challenge. After much engineering, the answer was the Cle Elum Fish Passage Facility, a multi-intake system that allows smolts to out migrate through 80 feet of reservoir elevation variation. From the intake, smolts enter a helix structure, much like a parking garage spiral, that delivers smolts to a tunnel returning to the river. Designing the helix to move fish efficiently without injury was difficult.

Helix Fix

Major Investment

This is not a cheap solution. Cle Elum fish passage is estimated to cost $132 million, shared equally by Reclamation and the State of Washington. A 100-foot deep shaft and other preparatory work has been completed. The project is currently in its third phase, constructing the helix and the intake structure. Both juvenile passage and adult passage is anticipated by 2024.

Fish passage at Cle Elum is a major investment of resources. The project is anticipated to provide access to habitat for sockeye, spring chinook, coho, steelhead, and bull trout. One of the ways that

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Yakima Basin Plan

Fishery Storage

Water Marketing

Agricultural Consumption

investment will be protected is by seeking federal designation of the Cle Elum River and tributaries above the reservoir as Wild and Scenic Rivers. Protecting the reintroduced fish is part of the rationale for the designation.

For fishery interests in the basin, the Cle Elum projects alone are an enormous success. The pool raise represents the first storage water dedicated to fishery use in the basin. Fish passage at a Reclamation reservoir has been sought for decades, even generations. Both were authorized (1994 and 1984) for decades without moving towards construction. With the changed political context of YBIP, these projects are nearing completion.

Water Conservation and Voluntary Transfers

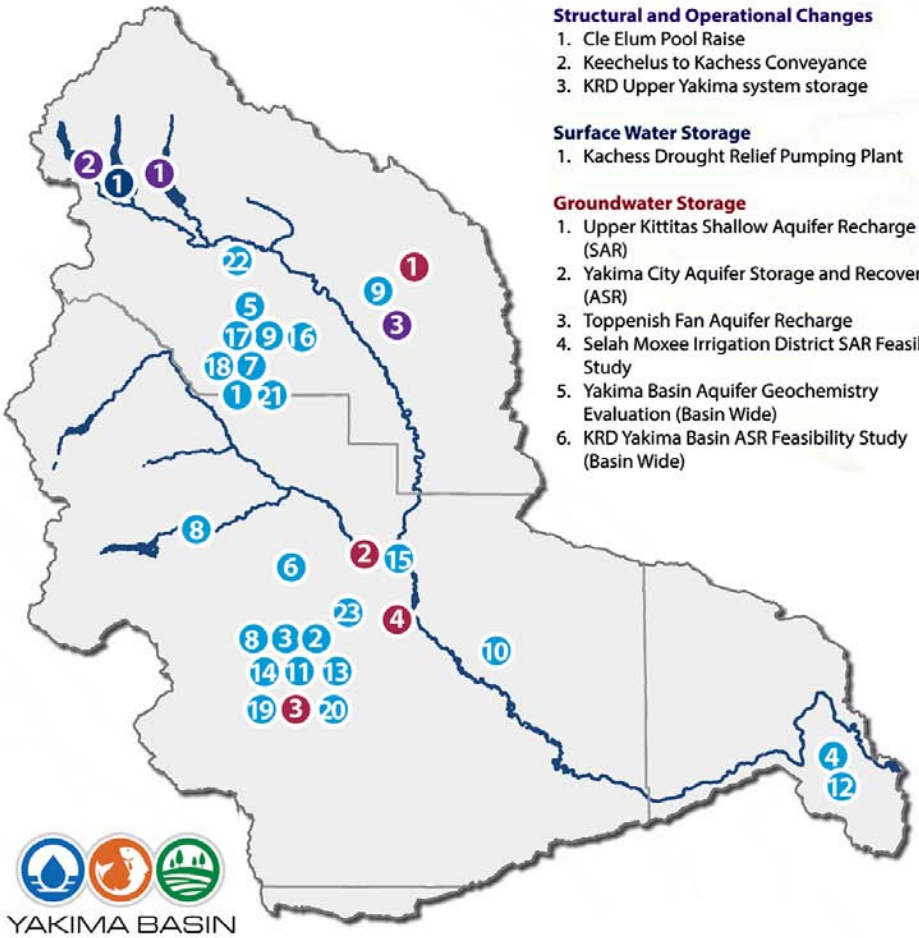
While developing additional water storage and fishery restoration receives the most attention in YBIP, the heart of the plan is making best use of existing water supplies, specifically through conservation and marketing.

YRBWEP II Conservation

Reclamation's Yakima Project dates to 1905. It was designed to operate using gravity, which required canals be kept full, and flood or rill irrigation. The Yakima Project diverted a large amount of water that ultimately returned to rivers far downsteam as operational spill from canals kept full to the end of their runs, or as return flow from excess water applied to fields. As water supplies have grown less reliable, this inefficiency simply could not continue. Conservation was at the heart of the 1994 YRBWEP II legislation, including a goal of 160,000 AF of conservation focused on the mid and lower basin (P.L.103-434 §1203). For the first 20 years of YRBWEP II, many irrigation districts were reluctant to conserve water out of concern that conservation would reduce water rights being adjudicated in the *Aquavella* litigation. As resolution of the litigation neared, interest in conservation boomed.

Yakima Basin Integrated Plan Initial Development Phase

Map I - Conservation, Storage, Operations, and Water Market Projects



YAKIMA BASIN
BUILDING A FUTURE FOR WATER, WILDLIFE & WORKING LANDS

Locations are Approximate

Structural and Operational Changes
1. Cle Elum Pool Raise
2. Keechelus to Kachess Conveyance
3. KRD Upper Yakima system storage

Surface Water Storage
1. Kachess Drought Relief Pumping Plant

Groundwater Storage
1. Upper Kittitas Shallow Aquifer Recharge (SAR)
2. Yakima City Aquifer Storage and Recovery (ASR)
3. Toppenish Fan Aquifer Recharge
4. Selah Moxee Irrigation District SAR Feasibility Study
5. Yakima Basin Aquifer Geochemistry Evaluation (Basin Wide)
6. KRD Yakima Basin ASR Feasibility Study (Basin Wide)

Agricultural and Municipal Conservation (2013-2019)
1. KRD 13.6, 13.8 Lateral Piping Project
2. Wapato Irrigation Project (WIP) Piping Lateral 4-414C
3. WIP Piping Satus East Lateral E73
4. Kennewick Irrigation District (KID) Division IV Lining
5. Manastash Creek Sprinkler Conversions
6. Yakima-Tieton ID Diversion Relocation Feasibility Study
7. Manastash – Consolidated Pipeline & Manastash Water Ditch Association (MWDA) Pipeline Construction
8. WIP Piping of Unit 2 L672 and Headworks Rebuild
9. KRD North Branch Canal Lining
10. Roza Canal Lining Phases I, II, III, IV
11. WIP Lining of Unit 2 (167+20 to 173+80)
12. KID Reregulation Reservoir Design
13. WIP Unit 2 Upper Dam Rebuild and Lower Dam Removal
14. WIP Water Conservation Plan
15. City of Yakima Xeriscape Demonstration Project
16. Reed Pipeline Design Manastash Creek
17. Anderson Diversion Irrigation Water Acquisition
18. KRD South Branch Canal Lining, Phases I and II
19. WIP Unit 2 West Piping
20. WIP Unit 2 West Lining
21. KCCD Irrigation Efficiancy Improvements
22. KRD Upper Tributary Supplementation
23. WIP Track D Lateral Pipeline
24. Heritage Gardens Municipal Conservation Program (Basin Wide)

Water Bank/Exchange Programs
1. KRD/TU Yakima basin Water Market Structure and Strategic Development (Basin Wide)

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Yakima Basin Plan

To date, projects conserving 67,000 AF have been completed, with an additional 59,000 AF anticipated to be completed by 2023. While this anticipated 126,000 AF of conservation falls short of the 160,000 AF target, YRBWEP II conservation will continue until the target is met.

Conservation Flexibility

YBIP Enhanced Conservation

YBIP has a goal of 170,000 AF of water conservation in addition to YBWEP II, with half of that (85,000 AF) to be completed in the Initial Development Phase. YBIP's conservation approach is more flexible than YRBWEP in that it does not require measurable flow results in the mid and lower basin so it can be used in the upper basin and in the tributaries.

As of early 2019, projects conserving 11,522 AF had been completed, at a cost of about $11.8 million. Most of that money spent ($5.7 million) and water conserved (6,846 AF) is on the BIA's Wapato Irrigation Project.

Irrigation District Projects

District Conservation

Robust conservation is taking place outside of the YRBWEP and YBIP programs. Most producers in the valley have moved away from historic rill or flood irrigation to sprinklers and increasingly to drip or micro-sprinkler systems, especially for perennial crops such as tree fruit, hops, blueberries, and grapes. Irrigation districts are investing in system conservation, using district, YRBWEP, YBIP and other funding, through piping and lining canals, including:

- Yakima-Tieton Irrigation District: installed pressurized piping for its entire delivery system.
- Kittitas Reclamation District: lined 32 miles of canals and laterals and updated components; projects planned by 2023 will conserve 34,000 AF.
- Roza Water District: spent $43M in district funds to conserve 31,900 AF, built a reregulation reservoir, and plans to spend $33M over the next 15 years to conserve 8,500 AF.
- Wapato Irrigation Project (BIA irrigation project): spent $3.7 M to conserve 3,500 AF and is working on a prioritized system plan.
- Sunnyside Valley Irrigation District: conserved 35,000 AF through system improvements
- Kennewick Irrigation District: lined 74 miles of canals and piped 40 miles of laterals.

Water Market

Voluntary Transfers

In the Yakima basin, water markets and temporary transfers are currently an essential part of the drought response system and will be of growing importance in future years. During drought years, most transfers are from senior water right holders to the Reclamation districts with the less reliable supply. Roza Irrigation District, with vulnerable rights and valuable crops, is the most active market participant.

Transfers Study

Led by Kittitas Reclamation District and Trout Unlimited, YBIP is in the early stages of a study of increasing the role of voluntary transfers in the Yakima basin. This is a major effort conducted with the assistance of Washington State University Water Research Center — which has urged a greater role for marketing in the basin — as well as the University of Washington Evans School of Public Policy and Governance, private water marketers, basin attorneys, and basin irrigation districts. Yoder, J. et al. *Benefit-Cost Analysis of the Yakima Basin Integrated Plan Projects*, Washington State University Water Research Center, 2015. Available at: http://wrc.wsu.edu/documents/2014/12/ybip_bca_swwrc_dec2014.pdf . (S*ee also TWR* #135). With completion of the *Acquavella* adjudication, certainty of water rights — one of the typical preconditions for increased market transfers — has been met. The study will look at physical, institutional, and economic barriers, and is anticipated to be completed in 2020.

Range of Projects

Land and Habitat Projects

Investment in land acquisition and habitat improvement projects for the IDP is estimated at $361 million — a huge increase from investment in these types of projects prior to YBIP. More than thirty-three habitat projects have been completed or are underway, with a remarkable range of types of projects, including outright land purchase, levee setbacks, floodplain restoration, placement of large woody debris in streams, and dam removal. Several of the more unusual projects deserve highlighting.

Forest Purchase

Teanaway Acquisition

In 2013, the Washigton State Department of Natural Resources acquired 50,241 acres in the Teanaway River headwaters of the upper Yakima basin from a private forestry operator. The Teanaway River is the largest undammed tributary to the Yakima, and the land was being proposed for development. Acquiring the land and making it the State's first Community Forest managed for fishery restoration, recreation, and eventually timber harvest was a signature accomplishment of YBIP.

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Yakima Basin Plan

"Borrowed" Water

Tributary Supplementation

Flow Blocked

Tributary Stream Supplementation: Lending Water

During the drought of 2015, Kittitas Reclamation District (KRD) exhausted its water supply early in the summer and began shutting its system off. KRD realized that capacity in its canal system could be used to transport borrowed water to tributary streams that were drying up and stranding salmon and steelhead. KRD obtained permission to borrow water from downstream irrigation districts, divert it through the KRD canal system and re-water drying streams, keeping salmon alive. The water flowed back into the Yakima River to be picked up downstream by the lender irrigation districts. While the 2015 effort was an emergency effort, since then the system has been made permanent and assures water in seven tributaries. In non-drought years, the program is limited by canal capacity, with water conservation projects creating the needed capacity. KRD is considering expanding the program as canal capacity is developed.

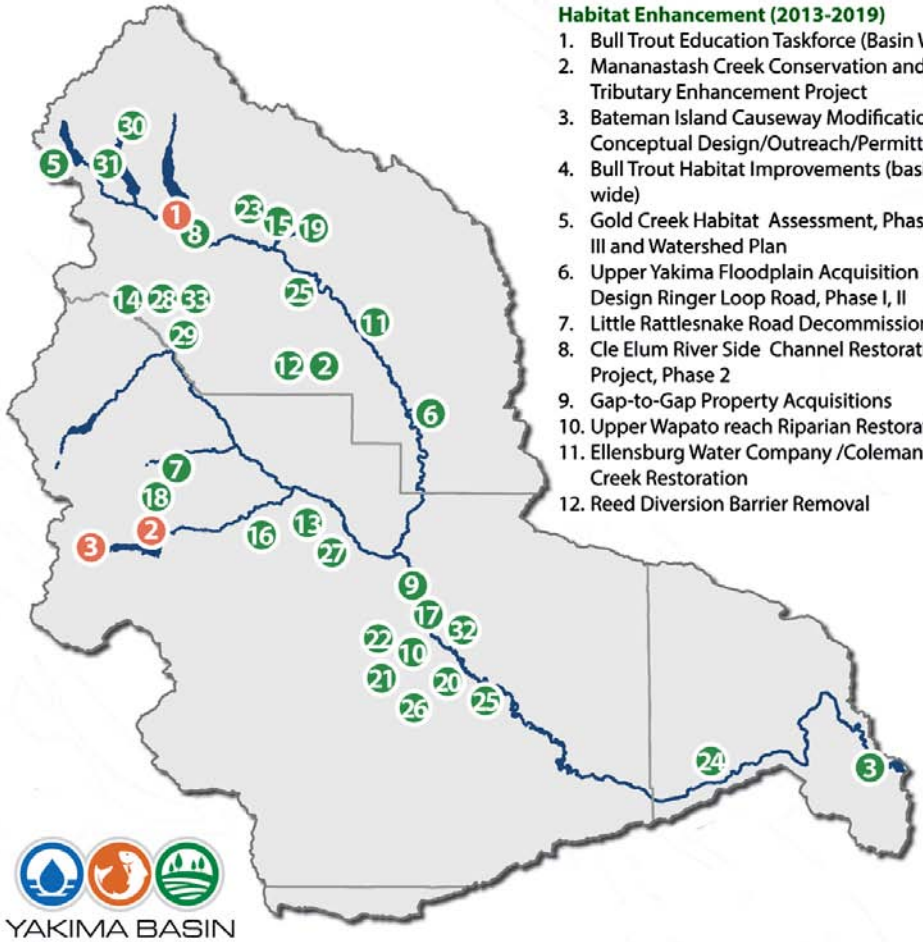
Use of KRD canals for tributary supplementation to protect fish could have happened in any of the dry years dating back decades…but it did not. This is a terrific example of a voluntary project that would not have happened without the collaboration fostered by YBIP and highlights the central role of water conservation.

Bateman Island Causeway Breach

At the mouth of the Yakima River, where it meets the Columbia River, lies Bateman Island. The Island splits the Yakima River into two sections with both entering the Columbia. A causeway from the shore to Bateman Island blocks flow in one reach, creating a backwater zone that is too warm for salmon smolts, creates a thermal barrier for migrating adult fish, and provides good habitat for invasive predatory fish that eat smolts. Breaching the causeway would reduce salmon mortality and speed migration. In 2019, the US Army Corps of Engineers commenced a Section 1135 study of breaching the causeway in collaboration with the State of Washington.

Yakima Basin Integrated Plan Initial Development Phase

Fish Passage and Habitat Enhancement Projects



Habitat Enhancement (2013-2019)

1. Bull Trout Education Taskforce (Basin Wide)
2. Mananastash Creek Conservation and Tributary Enhancement Project
3. Bateman Island Causeway Modification Conceptual Design/Outreach/Permitting
4. Bull Trout Habitat Improvements (basin wide)
5. Gold Creek Habitat Assessment, Phase I, II, III and Watershed Plan
6. Upper Yakima Floodplain Acquisition and Design Ringer Loop Road, Phase I, II
7. Little Rattlesnake Road Decommissioning
8. Cle Elum River Side Channel Restoration Project, Phase 2
9. Gap-to-Gap Property Acquisitions
10. Upper Wapato reach Riparian Restoration
11. Ellensburg Water Company /Coleman Creek Restoration
12. Reed Diversion Barrier Removal
13. Trout Meadows Acquisition /Enhancement
14. Little Naches Land Acquisition
15. Teanaway Valley Farm Acquisition and Restoration
16. Cowiche Easement/Design
17. Gap-to-Gap Outfall Relocation and Levee Removal Design and Restoration
18. South Fork Tieton Bull Trout Passage Feasibility and Design, Phase I, II, III
19. Teanaway/Indian Creek Restoration and Large Wood Replacement
20. Yakima Rivermile 89.5 Levee Breach
21. Island Road Floodplain Reconnection - Toppenish Creek
22. Toppenish Creek - Pop Pom Road
23. Teanaway Habitat Restoration and Fencing, Phase I, II, III
24. Lower River Thermal Refuge
25. Wapato reach Riparian Project
26. Yakima Basin Tributary Restoration (Starvation Flats, Ahtanum, Toppenish)
27. Naches River and Cowiche Creeek Restoration
28. Little Naches Large Wood Project
29. Fawn Creek Culvert Replacement
30. Kachess River Passage and Floodplain Assessment
31. Box Creek Large Wood Replenishment
32. Donald Wapato Bridge Restoration
33. Little Naches River Watershed Aquatic Restoration

Fish Passage

1. Cle Elum Dam
2. Tieton (Rimrock) Dam
3. Clear Creek Dam

YAKIMA BASIN
BUILDING A FUTURE FOR WATER, WILDLIFE & WORKING LANDS

Locations are Approximate

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Yakima Basin Plan

Floodplain Restoration

The land acquisition and habitat restoration projects are another great success of YBIP. Starting with the 50,000 acre Teanaway acquisition, the pace of protection has greatly exceeded that anticipated; the entire 70,000 acre goal for the 30-year YBIP has already been met. Additional land acquisition to meet a sub-goal for shrub-steppe habitat will be needed, however. Dozens of habitat projects have been completed, more are underway and still more are in planning. Yakima County and Kittitas County are leaders in the State in taking a restorative flood protection approach, using YBIP funding as well as the State's "Floodplains by Design" funding. Setting back levees and opening floodplains is a more reliable way of achieving flood risk mitigation, while at the same time meeting restoration goals.

Challenges and Successes

The process that led to YBIP started in 2008, with official launch of YBIP in 2013 through passage of state policy and funding legislation. A tremendous amount has been accomplished in the years since. The promise of the new approach of YBIP is being realized.

Political Support

Among the great successes of YBIP to date has been continuity and breadth of political support. The process started under Governor Christine Gregoire and continues with the full support of Governor Jay Inslee. YBIP received strong support under the administration of President Obama, which saw it as a climate adaptation project, and under the administration of President Trump, which sees it as supporting agriculture and infrastructure. In both Congress and the Washington legislature the project attracts bipartisan support. Political support is due to the continuity of YBIP's "unusual bedfellows" coalition.

Funding

Political support is terrific, but financial support is essential. To date, the State has appropriated more than $244 million for YBIP and its projects. Federal funding is harder to calculate because of the many different sources but totals more than $120 million from Reclamation alone since 2013. Overall, funding is increasing but lagging compared to the scale and scope of projects proposed. A huge step forward was Roza Irrigation District's proposal to finance, construct, and operate the KDRPP project — a commitment of more than $200 million.

The ten-year IDP is anticipated to cost about $990 million. However, the average annual spending from all sources has not approached the amount needed to meet that total. On funding, there is more work to be done.

Meeting Goals

It is fair to ask how YBIP is doing meeting goals. While some of the YBIP goals are in process or are hard to concisely summarize, in several areas the goals are easy to summarize.

Yakima Basin Integrated Plan (YBID)
Initial Development Phase Goals

Category	Goal	Accomplished	In Progress
Water Storage	214,600 AF	Cle Elum -14,600 AF	KDRPP – 200,000 AF
Water Conservation	YRBWEP 160,000 AF YBIP – 85,000 AF	67,000 AF 11,522 AF	59,000 AF Remainder
Fish Passage	Cle Elum Clear Lake Rimrock		In construction In planning Early planning
Land Acquisition	70,000 acres (YBIP 3 phases)	70,000 acres	Additional shrub-steppe land needed
Groundwater		City of Yakima Aquifer Storage & Recovery	Upper Kittitas- study Toppenish fan – study Basin - study

Adaptation

Adapting to changing conditions is both a success and challenge. When the 30-year plan for YBIP was created changes were known to be inevitable and welcomed. An example is KDRPP, where the Reclamation's shore-based pumping plant was too expensive, but Roza's floating pumping plant may be feasible. Other new water supply and restoration projects are being developed that may supplement or supplant the ones proposed in YBIP, especially where they are cheaper or more effective. A formal process for evaluating these new projects is in development, reserving, of course, judgment to the state and federal decision makers.

Opposition Litigation

Objections

YBIP was designed to accommodate a wide variety of interests, but not every perspective is satisfied with the plan. On July 8, 2019, Kachess Lake homeowners and an environmental organization filed a federal lawsuit alleging violation of a variety of state and federal laws. Resolving the litigation will likely take some time.

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Yakima Basin Plan

Return Flow

Another stakeholder with concern is Kennewick Irrigation District (KID), a Reclamation supplied irrigation water district serving an increasingly suburban base in the lowest part of Yakima River Basin. KID has junior (proratable) water rights but benefits from inefficiencies upstream, which allow it to take more than its prorated water right from return flow in drought years. With increasing conservation, KID is seeing this excess supply diminished. KID demands that its excess water supply not be diminished by conservation, a demand it backs with language in YRBWEP II legislation.

Opposition from interests adversely affected by YBIP projects, or opposition based on policy and philosophy to the YBIP approach, is likely to continue.

Institutional Transitions

Continuity

Continuity in leadership, even when personnel changes, has resulted in great results over the last decade. YBIP was founded on an agreement to agree. Several of the people important in reaching agreement on YBIP have changed jobs, retired, or even died, with more changes anticipated. As new people join the process, conserving institutional memory, retaining institutional loyalty to the premise of the plan, and developing personal connections is critical. YBIP has thrived through these changes in leadership and personnel. However, as the initiative becomes more formal, there is a need to develop institutions and procedures that will make individual transitions easier.

Conclusion

Collaboration Necessity

YBIP is an initiative born out of necessity — the various stakeholders could not live with their situation but could not make progress on their own. The only solution was to collaborate on a plan that addressed the major problems of the Yakima basin in an integrated, coordinated plan. Reaching that point was difficult. Implementing the resulting plan is proving just as complicated.

Successes

The results of collaboration and implementation are evident. Water is being conveyed and used more efficiently, allowing more precise delivery and helping producers survive a drought year such as 2019. Salmon, steelhead, and bull trout conservation and restoration projects are being undertaken throughout the basin, with many already completed. More than 70,000 acres of habitat was acquired, benefiting fish, wildlife, and recreation — an unheard-of result for a "water supply project" project. Fishery restoration projects blocked for decades by politics are being accomplished, such as the Cle Elum pool raise and fish passage. Innovative groundwater storage and surface water storage projects are in review, in construction, or completed. Perhaps the most telling measure of success is that new projects consistent with YBIP are in development — YBIP's integrated approach is fostering innovation and new ideas.

Enormous progress is being made. The reward for both the initiative and implementation is well worth the effort — a future that looks better for the fish, farms, forests, and families of the Yakima River Basin.

For Additional Information:
Steve Malloch, Western Water Futures LLC, 206/ 818-0482 or spmalloch@gmail.com

Steven Malloch is a Principal with Western Water Futures, LLC, where he provides strategy, program development, and implementation services for NGOs, foundations, and water managers. He brings technical, legal, and political tools to bear on the problems of improving the environmental performance of large Western water systems, including water supply, irrigation, and flood control projects, and on the pressing problems of adapting to the impacts of climate change on water infrastructure and use. A major ongoing project is supporting dam removal projects in Oregon, Washington, and Idaho as a consultant to the Resources Legacy Fund. Prior to forming Western Water Futures in 2013, Steve worked in Washington DC and Seattle on water resources for the National Wildlife Federation, Trout Unlimited, and as the Executive Director for the Western Water Alliance. Before shifting to the non-profit sector, Steve practiced environmental law and litigation in San Francisco with Graham & James. Steve started his career in water as a hydrogeologist, working on water supply and contamination projects in the Western US, Alaska, and internationally. His degrees are in geology and law from the University of California at Davis, with an MS in Water Resources Administration from the University of Arizona.

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Snake Basin Groundwater

DECLINING GROUNDWATER QUALITY IN THE EASTERN SNAKE PLAIN AQUIFER

CAUSES, TRENDS, AND PUBLIC HEALTH EFFECTS

Excerpts from a report by the Idaho Conservation League
Josh Johnson, Central Idaho Conservation Associate, Principal Author

Editors' Introduction: The following has been adapted from a 20-page report released by the Idaho Conservation League in July 2019. Some text and a number of graphics have been omitted. The full report is available for download from: www.idahoconservation.org/issues/water/

INTRODUCTION

Snake River Goals

The Idaho Conservation League (ICL) is currently engaged in a multi-year campaign to make the Snake River swimmable and fishable again. A key objective of ICL's Snake River campaign is to improve groundwater quality in the Eastern Snake Plain Aquifer (ESPA) — an integral piece of the Snake River system.

The purpose of this report is to provide an overview of the main threats to groundwater quality in the ESPA, examine trends in the available water quality data, and highlight public health concerns stemming from aquifer contamination — in short, to provide a snapshot of the current health of the aquifer.

Declining Aquifer Health

The overall health of the aquifer is declining. The sources and nature of pollution that is primarily affecting groundwater quality in the ESPA is well established (e.g., Frans et al., 2012; Skinner and Rupert, 2012; Rupert et al., 2014). Proliferation of irrigated agriculture and the rapid growth of the industrialized dairy industry have resulted in significant quantities of nutrients (primarily nitrogen and phosphorus) being introduced to the landscape. These nutrients have steadily infiltrated the groundwater and caused contamination problems. Most significant among these issues is nitrate contamination, which is already widespread in the ESPA and continues to increase in severity (Mahler and Keith, 2002; Skinner, 2017). The existence of formal Nitrate Priority Areas confirms that such problems exist (Mahler and Keith, 2002; Mahler et al., 2007).

Degraded groundwater quality has been shown to lead to a host of health problems and presents a serious threat to one of the most important aquifers in Idaho.

OVERVIEW

Dairy Industry Growth

Groundwater quality in the Eastern Snake Plain Aquifer (ESPA) is declining as a result of contamination by the over-application of fertilizers and animal waste across the Snake River Plain. It is particularly susceptible to contamination due to a host of geologic factors and pollutants from human activities. Of particular concern is the rapid growth of the industrialized dairy industry. The estimated 417,000 dairy cows in the ESPA's Magic Valley produce as much manure as a city of 12 million people (IDA, 2017). The nitrogen and phosphorus input from fertilizer and animal waste far exceeds what typical crops can uptake, and the remainder is susceptible to entering the groundwater.

The ESPA is southern Idaho's most important source of drinking water and supplies drinking water to over 300,000 Idahoans.

Water Quality Issues

Based on a review of available data and literature, we draw the following conclusions regarding groundwater quality in the ESPA:

- Nitrate contamination is a widespread and growing issue in the ESPA, with over two-thirds of sampled wells in the Magic Valley having measured concentrations above natural background levels, and in some areas, exceeding state/federal water quality standards.
- Limited phosphorus data indicates that this type of contamination is also growing and has the potential to exacerbate existing problems in the Snake River.
- Available data and modeling studies strongly indicate that nitrate and phosphorus concentrations will continue to increase in the coming decades.
- These water quality issues will increasingly have more severe implications for Idaho's ability to meet water quality standards and protect the health of residents in the Snake River Plain.

Solution Needs

A combination of stricter regulation of fertilizer and animal manure application by the appropriate state agencies along with industry-wide implementation of best-management practices (e.g., cover crops, residue management, no-till planting) is necessary to begin to address these groundwater issues.

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Snake Basin Groundwater

EASTERN SNAKE PLAIN AQUIFER

Geography & Geology

Groundwater Flow

The ESPA covers approximately 10,800 square miles in southern Idaho. The underground aquifer generally mimics the surface geology of the Snake River Plain, a broad ground depression formed by repeated volcanism in the last 12 million years. The northern boundary of the ESPA generally coincides with the southern terminus of the numerous mountain ranges in central and eastern Idaho, while the southern boundary closely mirrors the course of the Snake River and never deviates more than ten miles south of the river. The overall groundwater flow from northeast to southwest parallels a gentle regional elevation gradient in that direction. This flow pattern results in two main areas of discharge from the aquifer to the Snake River: a series of springs near American Falls and the Thousand Springs area near Hagerman (Link and Phoenix, 1996).

Unique Geology

The unique geology of the Snake River Plain allows water to easily infiltrate the aquifer in voluminous quantities. Beneath the Snake River Plain, there is a very thick (~5,000 feet) stack of layered basalts formed during volcanism associated with the passage of the North American plate over the stationary Yellowstone hotspot. The basalt is highly fractured and surface water easily enters the aquifer through interconnected pore spaces characteristic to the rubbly lava flows. Most of the groundwater is present within the upper 300- 500 feet of the aquifer, with a total storage capacity roughly equivalent to that of Lake Erie (200 to 300 million acre-feet) (IDEQ).

Aquifer Recharge

The aquifer is naturally recharged by rain and snowpack runoff from Idaho's central and eastern mountains, and is currently supplemented by excess irrigation water and managed aquifer recharge.

Aquifer Uses

Groundwater Uses

The ESPA is the largest aquifer in Idaho and one of the most productive supplies of drinking and irrigation water in the world in terms of quantity. It is an US Environmental Protection Agency (EPA)-designated sole source aquifer that supplies drinking water to nearly 300,000 people in south-central and eastern Idaho, including the fast-growing I-86/84 corridor from Twin Falls to Rexburg. This aquifer enables land that would otherwise be high desert sagebrush to produce the bulk of Idaho's agricultural products and support extensive dairies and feedlots. In total, there are 2.1 million irrigated acres on the ESPA, about 60% of Idaho's total irrigated acres (IDWR, 2009). The generally high-quality, aquifer-fed springs along the Snake River support a robust aquaculture industry that earned the region the moniker "Trout Capital of the World." In total, it is estimated the ESPA region produces approximately 33% of all goods and services in Idaho, valued at $14.9 billion annually (IDWR, 2015).

ESPA CONTAMINATION ISSUES

Susceptibility to Contamination

Contamination Susceptibility Factors

The ESPA is noted to be especially susceptible to contamination compared to other aquifers due to both geologic and human factors (Rupert et al., 2014):

- Geologic Characteristics. The same characteristics that make the ESPA such a voluminous aquifer — well-drained soils and permeable volcanic rock — also make it susceptible to contamination. The high permeability of the aquifer, which stems from the fractured and porous nature of the basaltic rock, gives contaminants fast pathways into the groundwater system.
- Irrigation Techniques. Excess irrigation water applied to fields seeps into the groundwater, carrying nutrients and chemicals with it. That shallow groundwater is often withdrawn again and reapplied to the fields, which further concentrates nitrates and other dissolved constituents.
- Young Groundwater Age. The average age of groundwater in the ESPA is only 15 years (Plummer et al., 2000). Young groundwater is more susceptible to contamination because most contaminants are associated with human activities that came into practice within the last 60 years.
- Oxic Conditions. Groundwater in the ESPA typically displays oxic conditions, meaning it contains at least 0.5 mg/L dissolved oxygen (Rupert et al., 2014). In oxic conditions, nitrate is unlikely to break down into inert nitrogen gas and can therefore persist for decades in the groundwater system (Dubrovsky et al., 2012).
- Rapid growth of Idaho's dairy industry. Over the past 30 years, Idaho has become the third largest milk-producing state in the country (Lauer et al., 2018). Since 1980, the number of dairy cows has nearly quadrupled, and the average farm size has more than doubled since 2007 to 1240 cows per farm (ISDA, 2017).

Contaminants of Concern

Nutrients

The primary contaminants of concern affecting groundwater in the ESPA are nutrients such as nitrogen and phosphorus. These nutrients play an important role in growing plants. However, in excessive quantities they can become harmful to human health and the environment.

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Snake Basin Groundwater

Nutrients Sources

Dairy Cow Impacts

Soil Mobility

Groundwater Mixing

Regional Distinction

Nitrate Data

Human Activities

Concentrations Increasing

The primary nutrient sources affecting the ESPA are fertilizers and animal waste. Fertilizer use for agricultural purposes on the Snake River Plain increased dramatically after 1950 and currently is responsible for roughly 160,000 tons of nitrogen input annually (Frans et al., 2012). Since 1980, the number of dairy cows in Idaho has increased substantially, from 148,000 head in 1980 to 614,000 head in 2019 (USDA, 2019). The majority of these dairy cows are located in the Magic Valley region, which overlies the ESPA.

The average dairy cow produces over 33 times as much total nitrogen and 44 times more phosphorus than the average human in a given year. In terms of nitrogen input, the increase in dairy cows since 1980 is therefore equivalent to adding over 15 million people to the state in that timespan (current population of 1.79 million). The estimated 417,000 dairy cows in the Magic Valley (ISDA, 2017) produce manure resulting in a total annual nitrogen input equivalent to 14 million people.

The combined nitrogen and phosphorus input from fertilizer and animal waste far exceeds what typical crops can uptake; thus, the excess is susceptible to entering the groundwater (e.g., Hirsh and Weil, 2019). The mobility of these elements in soil dictates how much they can enter surface and groundwater due to runoff or leaching. There is an important distinction between nitrogen and phosphorus soil mobility. Nitrogen, specifically in nitrate form (NO3-), is very mobile in soils and therefore leaches relatively easily into the water (Jury and Nielsen, 1989). Phosphorus, on the other hand, is largely retained in soils by a process called adsorption and does not leach easily into water (Sharpley et al., 1993; Sharpley, 1995). This difference in mobility helps explain why nitrate has been a more prevalent problem than phosphorus in the ESPA thus far. However, recent research has shown that once a soil's capacity to adsorb phosphorus is exceeded and becomes oversaturated, the excess phosphorus will freely leach into the subsurface (Domagalski and Johnson, 2012). There are indications from recent soil studies in the region (e.g., Lentz et al., 2018) that this process is already underway in portions of the Snake River Plain.

GROUNDWATER FLOW DYNAMICS

To understand the pattern of groundwater contamination in the ESPA, it is necessary to understand the aquifer's groundwater flow dynamics. As shown in Figure 1, the aquifer geometry and thickness are such that regional groundwater flow is typically from northeast to southwest. The aquifer is recharged with generally high-quality, snowmelt-derived water, which eventually mixes with lower quality groundwater closer to the Snake River. This reduced-quality groundwater (see Figure 1, next page) derives mainly from agricultural runoff that has high levels of nitrogen. North of the Snake River, mixing of the shallow, high-nitrate groundwater with the deeper, low-nitrate groundwater occurs as the aquifer thins with increasing proximity to the river (Rupert et al., 2014). Without this geometry-induced mixing forcing the higher quality groundwater to the surface, nitrate concentrations would be even higher than are currently observed in the ESPA (Skinner and Rupert, 2012).

South of the Snake River, the aquifer is very thin and there is little to no upwelling of high-quality groundwater from deeper in the aquifer, as is often the case in the aquifer north of the Snake (Skinner and Rupert, 2012). Thus, these areas are particularly at risk from nitrate contamination because they do not have the benefit of dilution with deeper groundwater.

GROUNDWATER QUALITY

Nitrate

Most data regarding nitrate contamination in the ESPA comes from a series of US Geological Survey (USGS) reports published since 2005. These studies are not comprehensive across the ESPA, but rather present datasets focused on specific areas, such as the Magic Valley. Most nitrate data from the Idaho Department of Environmental Quality (IDEQ) are from 2001 to 2010, with more recent nitrate data available only for wells in Lincoln County (see 'Data Needs' section, below). The available groundwater datasets clearly indicate that nitrate contamination is a widespread and growing issue.

Low levels of nitrate are naturally occurring in groundwater, but concentrations above 2 mg/L indicate that human activities have put nitrate into the groundwater (Mahler and Keith, 2002). In our analysis of available IDEQ data for the Magic Valley (Gooding, Twin Falls, Lincoln, Minidoka, Jerome, and Cassia Counties), 69% of all well samples had measured NO3 concentrations greater than background levels (>2 mg/L). This same dataset also indicates that one-third of all samples had NO3 greater than 5 mg/L, which is starting to approach levels that are dangerous for human health.

In 2017, the USGS published a report on groundwater quality in Jerome and Gooding Counties. In this report, groundwater samples were taken from 36 wells and analyzed for a number of constituents, including nitrate. Data showed generally increasing concentrations with increasing proximity to the Snake River, consistent with expected concentration patterns based on groundwater flow dynamics. NO3 values above 2 mg/L were widespread in southern Jerome County and southeastern Gooding County, with an isolated maximum of 9.93 mg/L (Skinner, 2017).

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Snake Basin Groundwater

"Nitrate Priority Areas"

IDEQ has identified 34 "**n**itrate **p**riority **a**reas" (NPAs) throughout the state during their last assessment in 2014. These are areas where at least 25% of wells sampled have nitrate concentrations of 5 mg/L or greater. Nine of the 34 NPAs in Idaho are located within the ESPA, including the top priority area (Marsh Creek NPA in the Burley, ID area). In the 2014 assessment, wells sampled within the Marsh Creek NPA were found to have an average NO3 concentration of 7.16 mg/L and a maximum concentration of 40 mg/L, with an increasing trend from previous assessments (IDEQ, 2014). 89% of samples from Marsh Creek were found to have nitrate concentrations above background levels (> 2 mg/L), with 23% of samples in excess of the human health standard of 10 mg/L (IDEQ, 2014).

A 2012 USGS study analyzed existing nitrate data from the ESPA and found that most wells with numerous samples collected over time showed increasing trends in nitrate concentration (Frans et al., 2012).

Phosphorus Data

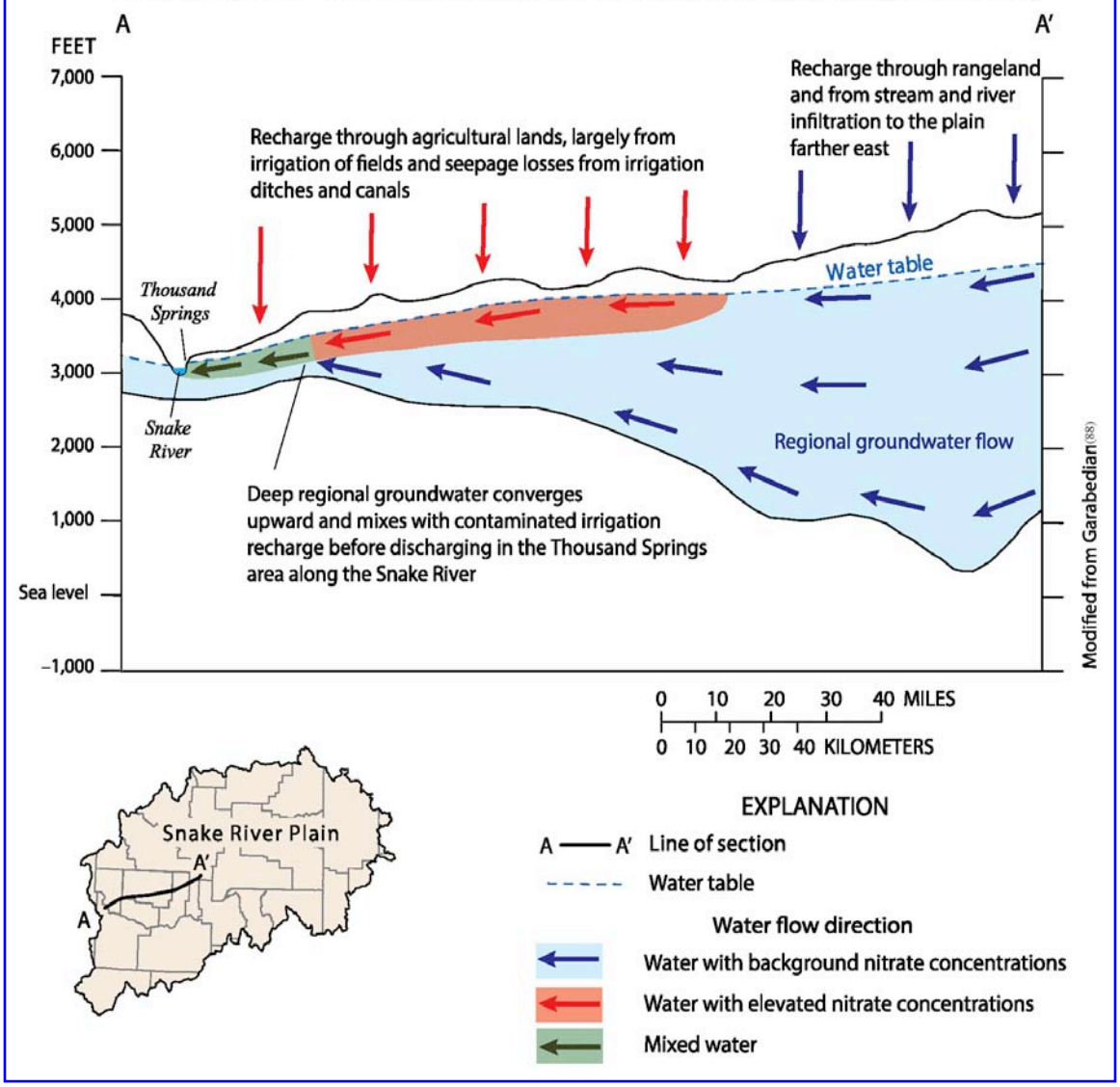
Phosphorus

Publicly available phosphorus data for the ESPA is currently limited to datasets collected by the Idaho Fish and Game (IDFG) at the spring inflows at their hatcheries along the Snake River, as well as a small dataset from a 2017 USGS study. There are numerous aquaculture facilities along the Snake River that rely on spring water from the ESPA; these facilities have additional data pertaining to the quality of their incoming water, but this data is available only at the discretion of the aquaculture facilities. There are not publicly available phosphorus concentrations for IDEQ well samples analyzed for nitrate in the Magic Valley.

Figure1

Diagram adapted from *Rupert et al.*, 2014 (pg 49)

How Groundwater Flow Patterns in the ESAP Influence Observed Nitrate Concentrations



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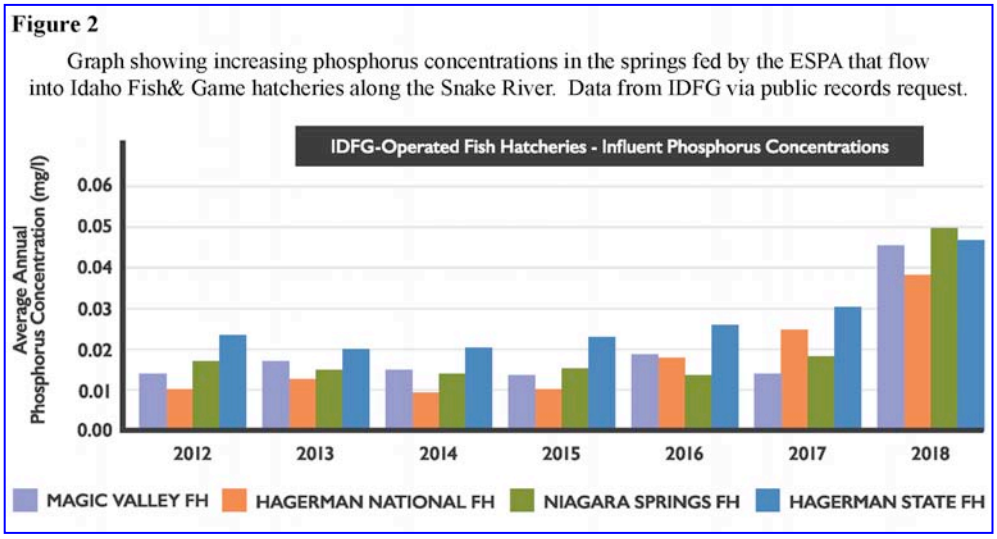
Snake Basin Groundwater

Phosphorus Increase

IDFG has phosphorus data for the four facilities they operate along the Snake River, which rely on spring water from the ESPA – Hagerman State Fish Hatchery, Hagerman National Fish Hatchery, Niagara Springs Fish Hatchery, and Magic Valley Fish Hatchery. These springs have complicated plumbing systems; they are fed by groundwater from the ESPA but can be responsive to surface water flows as well. IDFG's phosphorus data demonstrate a noticeable increase in phosphorus concentrations since 2011 at all four facilities (Figure 2). For example, the average phosphorus concentrations at Hagerman have more than doubled over a 6-year period, when comparing the 2017-2018 period to the 2011-2016 period. The consistency of increasing concentrations at each of the four hatcheries is notable. The maximum single-sample in fluent phosphorus concentration measured was 0.072 mg/L at the Magic Valley Fish Hatchery in 2018. For reference, the not-to-exceed total phosphorus concentration for that section of the Snake River has been set at 0.075 mg/L in order to protect beneficial uses.

Figure 2

Graph showing increasing phosphorus concentrations in the springs fed by the ESPA that flow into Idaho Fish& Game hatcheries along the Snake River. Data from IDFG via public records request.



Increasing Trends

Projected Trends

Several lines of evidence provide a compelling case that both nitrate and phosphorus concentrations will continue to increase for the foreseeable future in the ESPA:

Sources

Principal Sources: The driving force behind existing elevated nitrate and phosphorus concentrations — livestock and agricultural activities — show no signs of slowing down. According to the 2017 Industry Profile published by Dairy West and the Idaho Dairymen's Association, the Magic Valley alone is home to nearly 417,000 dairy cows. Given that the average 1,400-lb dairy cow produces about 120 pounds of waste per day (LPELC, 2019), over 50 million pounds of dairy waste are created every day in the Magic Valley alone. Despite efforts to manage nitrogen and phosphorus on large dairy farms, this remains a staggering input to the lands above the aquifer. Agricultural fertilizer use also remains high across the Snake River Plain, accounting for at least 60,000 tons of nitrogen input every year (Skinner and Rupert, 2012). Both the number of dairy cows and amount of fertilizer use in the Snake River Plain are likely to increase, leading to correspondingly increasing nitrate concentrations (Rupert et al., 2014).

Nitrate Modeling

USGS Nitrate Modeling: USGS numerical model simulations of nitrate in the ESPA indicate that even if nitrogen input were held constant for the next several decades, concentrations would continue to increase for a significant amount of time before eventually leveling off (Skinner and Rupert, 2012). This same study also showed that if all agricultural nitrogen input was stopped immediately, nitrate concentrations would begin to decline in 5-10 years. This phenomenon highlights the notable lag time between land use activities and changes in groundwater quality (Rupert et al., 2014).

Phosphorus Saturation

Phosphorus Saturation: There is increasing evidence that continued phosphorus loading from animal waste and other sources has begun to saturate soils in the Magic Valley, which prevents phosphorus adsorption and leads to increased leaching of dissolved phosphorus into the groundwater (Lentz et al., 2018). Previous studies have shown that once phosphorus leaching zones develop, they can have long-term, negative effects on groundwater quality that take several decades to return to levels compliant with water quality standards (Schoumans and Groenendijk, 2000; Sharpley et al., 2013). Notable increases seen in the limited phosphorus data available are cause for concern that this process is underway in some portions of the ESPA, which could lead to increases in: outbreaks of toxic algae in aquifer-fed surface waters; reduced oxygenation of ground and surface water; and other environmental and public health concerns.

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Snake Basin Groundwater

Nonpoint Sources

Surface Water Impacts: Sources of nonpoint source pollution to surface water (such as agricultural and manure fields) continue to have a large regulatory loophole in the Clean Water Act as they are not regulated with discharge permits and associated limits in the same manner as is point source pollution (e.g. from a wastewater treatment plant). Since groundwater quality is also not regulated by the Clean Water Act, if/when this polluted surface water enters the groundwater, the sources of that pollution will also not be regulated in this manner.

Significant Variance (Hotspots)

Based on the available information, it is likely that nitrate and phosphorus concentrations will continue to rise in the ESPA for the foreseeable future — even if all such inputs were stopped tomorrow. Due to the previously discussed complexities of the groundwater system, this increase in nutrient concentrations will vary significantly based on location. Based on numerical modeling simulations, a recent USGS report concluded that current hotspots of high concentrations will continue to increase in severity (e.g., southwest Minidoka County, northern Twin Falls and Cassia counties) (Skinner and Rupert, 2012). These hotspots are modeled to have average nitrate concentrations of 8-12 mg/L. Based on these figures, those hotspots would likely violate state and federal water quality standards designed to protect public health. Paradoxically, areas of high nutrient input, such as western Jerome County and southern Gooding County, will continue to have relatively low nitrate concentrations (<2 mg/L) because of consistent upwelling of low-nitrate groundwater in those areas (Skinner and Rupert, 2012).

IMPLICATIONS

Failure to Meet Water Quality Standards

Drinking Water Standard

If current trends continue, it is increasingly likely that the federal/state nitrate drinking water standard of 10 mg/L — which is linked to human health concerns — will be violated in the vicinity of communities such as Twin Falls, Buhl, and Paul. Based on USGS numerical modeling, areas that are at higher risk of having water that violates human health standards include northern Twin Falls County, northwest Cassia County, and southwest Minidoka County (Skinner and Rupert, 2012).

Flow Pattern Impact

Because the spatial distribution of projected nitrate concentrations is primarily controlled by the flow patterns of the aquifer, the problems caused by high nitrogen inputs from large dairies and farms may show up in unexpected areas that seem not to be linked to those problems. Thus, there is some concern that the large farms and dairies in much of Jerome and Gooding counties, for example, can continue to input significant quantities of nitrogen into the system without seeing the consequences in the quality of the water that they use because the resulting contamination will show up down-gradient from them.

Snake River Impairment

Idaho does not have a public health groundwater quality standard for phosphorus because it is not directly linked to human health effects in drinking water. However, the aquifer feeds numerous springs that discharge into the Snake River, which is listed as impaired for phosphorus for its entire length along the ESPA. Excessive levels of phosphorous in the river contribute to elevated levels of aquatic plant growth that reduce oxygen levels, leading to fish kills and reduced habitat quality. Excessive phosphorus also contributes to outbreaks of toxic algae, which poses a serious human health risk.

Phosphorus Narrative Standard

To meet their narrative water quality standard to prevent excess nutrients, IDEQ has set a target to reduce current phosphorus levels to 0.075 mg/L in the mainstem Snake River between Milner Dam and King Hill. This target is not currently being achieved primarily due to nonpoint source pollution. If the springs that recharge the Snake River are also carrying significant phosphorus loads, it will exacerbate the nutrient-related problems on the mainstem Snake River and lead to continued violation of surface water quality standards in that reach. This will have serious and costly implications for existing point source dischargers on the middle Snake River.

Public Health Issues

Nitrate Standard

Nitrate is a well-established cause of human health problems when it is found in drinking water above certain concentrations (Mahler et al., 2007). It is colorless, odorless, and tasteless in water and can only be detected by laboratory testing. EPA has set the federal drinking water standard for nitrate at 10 mg/L, above which it is scientifically proven to cause potential health risks.

Health Risk

The primary health risk associated with nitrate is blue-baby syndrome, which can affect infants younger than six months old. Bacteria in the digestive tracts of infants change nitrate into nitrite, which then enters the infant's bloodstream and reacts with hemoglobin (the molecule that carries oxygen in the bloodstream). This reaction produces a new compound called methemoglobin, which interferes with the blood's ability to carry oxygen. In the worst-case scenario, this process can result in decreasing oxygen levels leading to rare infant deaths (Mahler et al., 2007).

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Snake Basin Groundwater

Nitrate Effects

Algal Blooms

Proactive Approach

Monitoring Wells

Springs Data

CAFOs

CAFOs & Fertilizer

Regulatory Split

The long-term effects of drinking water with moderate to high levels of nitrate remains poorly understood (Mahler et al., 2007). However, studies have shown that long-term exposure to nitrate concentrations greater than 2 mg/L has possible links to bladder and ovarian cancer (Weyer et al., 2001) as well as non-Hodgkins lymphoma (Ward et al., 1996). More research is ongoing to determine a direct link between elevated nitrate concentrations and long-term health risks; however, at this time, EPA does not include a carcinogenicity evaluation for nitrate (ATSDR, 2017).

The presence of phosphorus in groundwater is not known to have direct human health effects. However, phosphorus in the ESPA contributes to the overall rise of nutrient concentrations in the Snake River. The overabundance of phosphorus in the Snake River has contributed to the formation of harmful algal blooms, particularly in the numerous slow-moving reservoirs along the length of the river. Recent research demonstrates that phosphorus is the key driver of algal blooms in stagnant water environments like reservoirs and lakes (Higgins et al., 2017). In some circumstances, harmful algal blooms can produce toxins that cause a variety of illnesses in humans (Fleming et al., 2002). Outbreaks of harmful algal blooms on the Snake River and its reservoirs regularly result in closures of swimming areas and presents dangers to humans, animals, livestock, and pets.

Thus far, nitrate and phosphorus pollution in the ESPA have not resulted in noticeable, widespread effects to human health. However, with the contamination problem expected to worsen in the coming decades and continued rapid population growth in the Snake River Plain, there is concern that human health impacts stemming from poor groundwater quality will surface and escalate. Delaying action would endanger more people and lead to a much more expensive remedies.

DATA NEEDS

As this report highlights, state and federal regulatory agencies need to obtain a better understanding of the scope and severity of the groundwater quality issues in the ESPA. The existing data is only sufficient to highlight a growing problem, not to fully characterize the issue.

We identify the following data needs:

Creation of a widespread monitoring well network across the Magic Valley, with quarterly nitrate and phosphorus sampling and data compiled in a publicly accessible database. Well sites should be preferentially located in areas of known high nutrient contaminations based on aquifer geometry and dynamics. Up-gradient well sampling should be incorporated as well to provide a natural background.

Monthly nitrate and phosphorus data collection from major springs entering the Snake River from the ESPA, compiled in a publicly accessible, user-friendly database.

Creation of a nutrient input inventory for **c**oncentrated **a**nimal **f**eeding **o**perations (CAFOs).

Obtaining and compiling this data is necessary to ensure state compliance with groundwater and surface water quality standards and safeguard public health.

However, the need for better data should not serve as an excuse for inaction where it matters most — reducing the pollution that is causing the problem.

CONCLUSIONS

NEXT STEPS

Rising nitrate and phosphorus concentrations in the ESPA are a growing problem that has serious implications for public health and the state's ability to meet its surface and groundwater quality standards. The available groundwater quality data, while limited, clearly indicates that nitrate and phosphorus concentrations are well above natural background levels in certain portions of the ESPA. These elevated concentrations are directly linked to human activities on the Snake River Plain — specifically, waste generated by large concentrated animal feeding operations and over-application of fertilizer on agricultural fields. These concentrations are projected to continue to rise for the foreseeable future with likely worsening human health risks. To meaningfully address this growing problem, action is needed both by the state agencies that play a role in protecting the quality of Idaho's groundwater and by the agricultural and dairy industries, whom are responsible for the lion's share of nitrogen and phosphorus inputs.

An important first action would be to centralize the state's responsibility of groundwater protection under a single regulatory agency. The current regulatory structure, as defined by the Idaho Ground Water Protection Interagency Cooperative Agreement, splits the responsibility of groundwater quality protection and sampling among five different state agencies — a highly disjointed and ineffectual approach that ultimately contributes to inaction. Consolidating this responsibility would improve the effectiveness, accountability, and transparency of the state in dealing with matters of groundwater protection — a significant step toward addressing groundwater quality issues in the ESPA and elsewhere across Idaho.

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Snake Basin Groundwater

Stricter Regulation

Best Management Practices

Timely actions are desperately needed to reduce the pollution problem itself. A combination of stricter regulation of fertilizer and manure application along with industry-wide implementation of best-management practices (e.g., cover crops, residue management, no-till planting) is necessary to begin to address these groundwater issues. In particular, we must find a solution to the 30 million pounds of dairy waste produced every day in the Magic Valley. Without changes to how manure is currently dealt with on the Snake River Plain, the nitrogen and phosphorus inputs to the groundwater will continue to increase and cause worsening contamination problems in the ESPA.

Simply maintaining the status quo is unacceptable if we want to protect the quality of our groundwater in the Eastern Snake Plain Aquifer.

The Idaho Conservation League will continue to work with the relevant stakeholders and state agencies to address this issue head-on.

For Additional Information:

Josh Johnson, Idaho Conservation League, 208/ 726-7485 x1 or jjohnson@idahoconservation.org

Josh Johnson, Central Idaho Conservation Associate, uses his technical background in geology, experience in environmental education, and love for the outdoors to protect those very things that make Idaho a special place to live. His work portfolio includes public lands, mining, air and water quality, and efforts to clean up the Snake River. Josh earned a B.A. in geology at Middlebury College and a M.S. in geology at the University of Colorado. He also worked as an interpretive park ranger in the Tetons and a mentor naturalist at the Aspen Center for Environmental Studies prior to joining ICL's Ketchum office staff in 2017.

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Green Infrastructure

GREEN INFRASTRUCTURE FRONTIERS

USING NATURE TO TACKLE WATER INFRASTRUCTURE CHALLENGES
GREEN INFRASTRUCTURE RESEARCH & INNOVATION AT STANFORD

by Kim Quesnel, Bea Gordon, Perrine Hammel and Jordy Wolfland
(Water in the West Program, Stanford University)

Editors' Introduction: Author Bea Gordon provided the following update of an article which first appeared on the "Water in the West" website last May. Readers are encouraged to visit the website as numerous links to further information — not included here — are available at the site. *See*: https://localwitw.stanford.edu/news-events/news-insights.

Introduction

Multiple Benefits

Walking across the Stanford campus, it's not unusual to see flocks of active undergraduates playing soccer, serving volleyballs or just generally enjoying one of the many inviting lawns. At first glance, the scene seems like a poster for the benefits of college in California come to life. What the casual observer — and even most students — might not realize is that many of these spaces are serving multiple purposes. The soccer field, for instance, is also a detention pond, storing stormwater and preventing flooding, while also recharging our precious groundwater. The volleyball court, is a stormwater sand filter, slowly treating polluted runoff. The popular Meyer Green includes permeable pavement and landscaping to capture stormwater and provide a sunny recreation spot for students. Elsewhere, important changes are underway as well. Some campus irrigation is now supplied by harvested rainwater, parking lots throughout campus have been installed using porous pavement, and biofilters have been installed to improve aesthetics and infiltrate stormwater runoff.

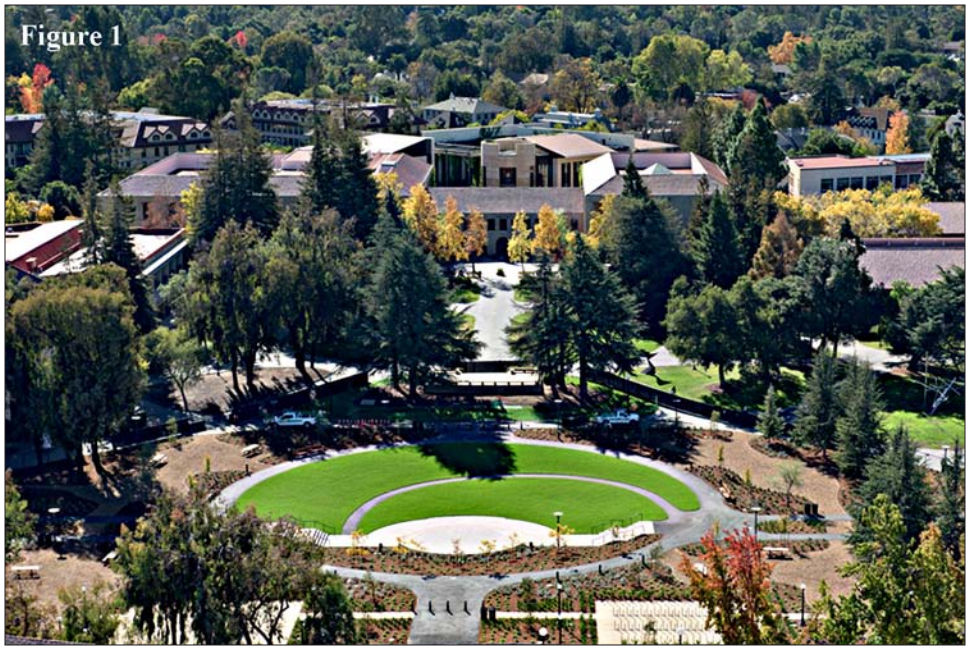

Figure 1: Meyer Green at Stanford University illustrates an example of how many spaces on campus can serve dual purposes. Photo credit: Stanford News Service.

Mimicking Nature

All of these natural systems are powerful examples of the way that green infrastructure — in contrast to more traditional grey infrastructure (e.g. pipes, engineered detention ponds, and treatment plants) — can reduce the flood risk by mimicking the hydrology of undeveloped "natural" systems. In this way, green infrastructure mitigates the risk posed by stormwater runoff to urban centers by harnessing natural processes, including soaking up excess water and slowly releasing it, while enhancing the livability of our communities. As the Stanford examples illustrate, green infrastructure is often designed to provide a diverse set of environmental, social, and even economic benefits.

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Green Infrastructure

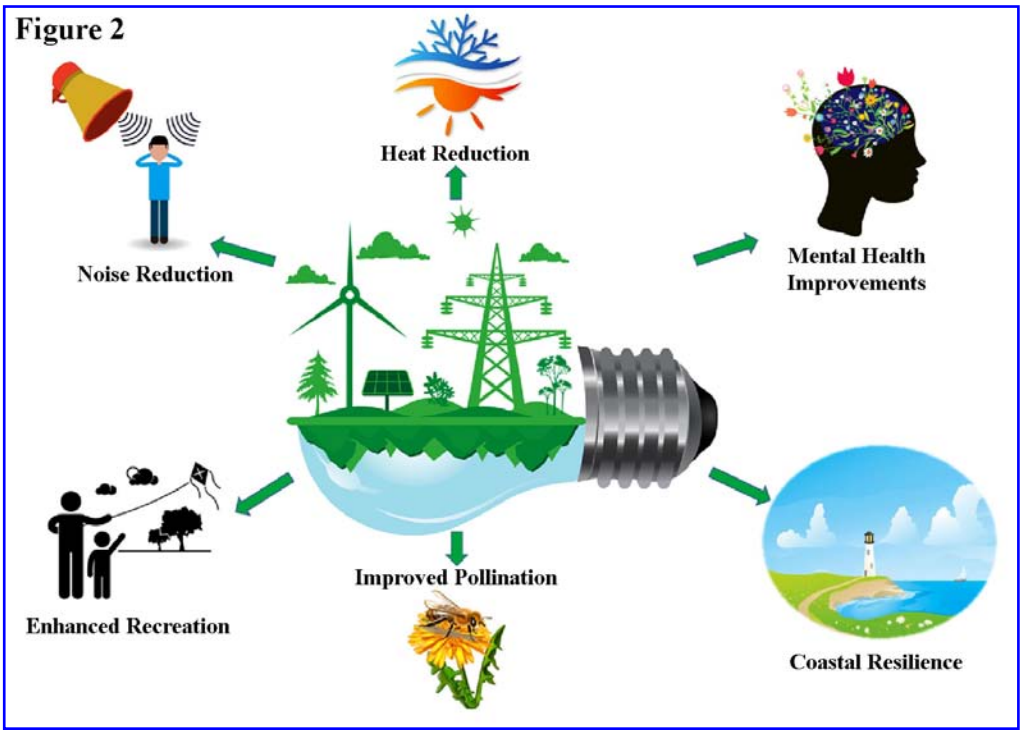
Versatility

Because of this versatility, green infrastructure has become a particularly attractive way to cope with the difficulty and cost of modernizing water infrastructure and management. At Stanford, a diverse group of researchers are studying how to integrate green infrastructure into our current systems, whether in the form of advancing technical knowledge about how green infrastructure operates or developing tools to measure the variety of benefits provided by these projects. In this piece, we dig in to how these research efforts on the frontiers of green infrastructure fit together to tackle bigger issues of climate change, urbanization, and aging infrastructure.

Quantifying Benefits

Green Infrastructure Benefits

Natural systems are the best way to capture and sustainably manage stormwater. As a result, green infrastructure is often first considered as a way to improve stormwater management. However, there are a multitude of other benefits that green infrastructure can provide. A team of researchers from the Stanford-based Natural Capital Project (NatCap) is currently investigating how to quantify these additional benefits, including noise and heat reduction, increased recreational opportunities and urban habitat creation, that are linked to green infrastructure (Figure 2). From NGOs to multilateral institutions or local governments, there is an increased interest in measuring these benefits to design more livable cities. The NatCap team is addressing this need by researching the impact of green infrastructure on air temperature, coastal protection, and mental and physical health. In addition to these primarily local co-benefits, some types of green infrastructure also help mitigate broader environmental issues, namely climate change and biodiversity loss, by storing carbon and providing habitat for diverse species. *See*: https://naturalcapitalproject.stanford.edu



Benefits

Figure 2: Benefits of green infrastructure can include: a) reducing air temperature, which alleviates public health risks during heat waves; b) supporting nearby crop pollination or providing forage for honey bees; c) protecting coastal properties and communities by buffering against coastal hazards; d) providing recreation opportunities; e) improving mental health, i.e., improving cognitive functions or reducing stress levels simply by seeing or being in nature; and f) reducing air and noise pollution, although the magnitude of these effects is debated.

Modeling Tools (Maps)

To factor these benefits into infrastructure decisions, the team also develops modeling tools aimed at urban practitioners. For example, NatCap is now expanding its software suite InVEST (Integrated Valuation of Ecosystem Services and Tradeoffs) to include the multi-sector benefits of green infrastructure. The software tool translates maps of urban environments, with various implementations of green infrastructure, into maps of benefits to communities. The goal is for this tool to enable communities to better identify and quantify the diversity of benefits related to green infrastructure when making stormwater management decisions. *See*: https://naturalcapitalproject.stanford.edu/invest/

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Green Infrastructure

Water Quality (Stormwater)

Pollutant Removal

Geomedia

Biochar

Filters Assessment

Plant & Fungal Processes

Scale

One of these benefits of particular interest to researchers at Stanford is the ability of green infrastructure to improve water quality. Green infrastructure provides immediate infiltration capacity for rainwater, which can prevent stormwater from flowing over impervious areas and gathering various urban pollutants. Modeling and empirical studies of green infrastructure performance have documented positive changes in water *quantity*: reduced peak flow, runoff volumes and increased groundwater recharge. However, managing stormwater quality remains an important area of research. Many pollutants are present in stormwater including nutrients, suspended sediment, metals, and trace organic contaminants (e.g., detergents, pesticides and pharmaceuticals).

Recognizing this need, researchers at Stanford's Engineering Research Center for Re-inventing the Nation's Urban Water Infrastructure (ReNUWIt) are developing green infrastructure systems that are optimized to remove these pollutants. Improvements to current green infrastructure include modifying the hydraulic properties of the systems, optimizing plant and fungal processes, and replacing the typical geomedia (generally a mix of compost and sand) with alternatives that provide better pollutant removal. *See*: http://renuwit.org.

This research has been piloted in Sonoma County and Los Angeles. Stanford researchers worked with Sonoma County Water Agency and partners in the City and County of Los Angeles to install innovative treatment filters to see how different types of geomedia (e.g. woodchips, sand, biochar and compost) can remove pollutants. This research is of particular interest to arid cities like Los Angeles, where the filters can act as a pre-treatment for stormwater before it's reused for water supply. Stanford researchers have found that biochar, a type of charcoal, removes >99% of certain pollutants like pharmaceuticals and pesticides. They have confirmed biochar can also be used to reduce concentrations of fecal indicator bacteria, which are a proxy for fecal contamination.

Figure 3: Photo of field-set up of filter experiments in Sonoma County. Each column includes a different type of geomedia such as woodchips, biochar, straw or a combination. Stormwater runoff flows upward through each filter to be treated. Photo credit: Marc Teixido (UC Berkeley).

In addition, plant and fungal processes may play a role in breaking down chemical pollutants. ReNUWIt researchers have found that plants and fungi can degrade urban-use pesticides and roadway pollutants such as deicing fluids. Design improvements like these to green infrastructure may help cities comply with water quality standards at the watershed scale. One finding of this research is that small improvements to performance (at the individual best management practices level) may result in large improvements in water quality at the watershed scale, resulting in potential for significant cost savings.

Implementing Green Infrastructure

With the promise of providing a suite of benefits, green infrastructure can be a great asset for urban environments by achieving multiple goals at the same time. Successful implementation, however, is still a major challenge.

One issue is that some benefits remain difficult to measure quantitatively across projects. Should we invest in a project that makes this community healthier over a project that makes another community less vulnerable to heat waves? How can we weigh improvements to quality of life in comparison to project costs? How should we measure and compare these benefits in a methodical way?

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Green Infrastructure

Metrics

Local Assets

Open Spaces

Funding

Financing Factors

Implementation Framework

Performance Metrics

Risk Mitigation

One way to deal with these types of questions is to use multi-objective assessment or try to translate all benefits into the same metric (e.g., economic value), but determining how much communities value each type of benefit is complicated. Additionally, planners need to consider other factors that will make the project a success: the history of the site; multiple (and sometimes conflicting) priorities by stakeholders; community engagement; and preferences for one type of project over another.

For a test case, NatCap has been working in the San Francisco Bay Area with multiple planning and conservation organizations to understand the value of local natural assets in hopes of protecting them in the future. Arguably the most challenging part of this endeavor has been navigating the priorities and relationships between various stakeholders to define the most meaningful questions and a path forward.

The project team decided to focus on a network of open spaces of special importance for the region. The research delivered quantitative measures of a range of ecosystem services— coastal protection, recreation and stormwater retention — provided by the open spaces, which can be used in regional urban planning. Some of this work is being implemented in the Bay Area Greenprint website, which is an online tool that planners in the Bay Area can use to incorporate built natural resource conservation in policy and action (www.bayareagreenprint.org/). The effort is led by multiple conservation organizations and hopes to mainstream green infrastructure information in regional and urban planning.

Despite clear potential benefits, communities around the world face a series of barriers in practically implementing and scaling green infrastructure systems. Finding funding is most often identified as one of the primary barriers by utilities, municipalities, and regions wanting to implement new green infrastructure projects or expand the scale of existing green infrastructure projects. It is no secret that the water sector is cash-strapped, but funding challenges can be particularly pronounced when it comes to financing innovative water solutions.

Financing can be difficult for many reasons: green infrastructure systems are distributed instead of centralized, the technology is new and uncertain, and the solutions are site-specific. One way to cross this funding barrier is by engaging with other sectors that can benefit from green infrastructure through better communication and tracking of multi-sector performance metrics. Water in the West has investigated mechanisms to help cities overcome this challenge by developing a case-study based framework for implementing green infrastructure that could be used to attract a diverse set of funders. *See*: https://doi.org/10.1016/j.jenvman.2018.06.029.

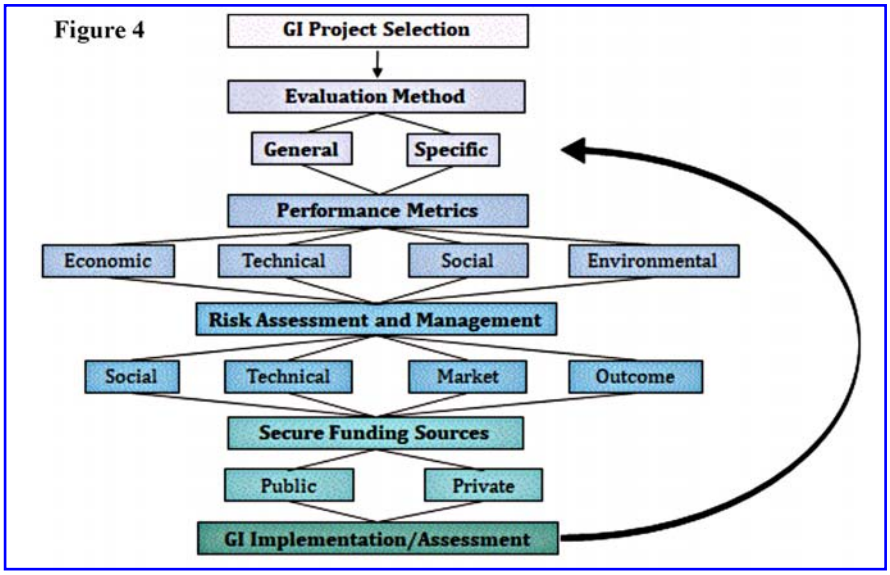

Figure 4: Conceptual Framework Organized Around a Circular Process That Includes Six Steps.

Through this high-level and global investigation, researchers at Stanford are seeking to identify how successful projects implement multi-sector performance metrics in the hopes that this can be replicated elsewhere. For example, better tracking of social benefits related to green infrastructure may incentivize investment in projects from organizations or funds interested in social justice. Perhaps one of the biggest questions this research is seeking to address is how different types of risk (e.g., social versus technical) impact financing opportunities. Looking at where and how risk has been mitigated around the globe may provide helpful guidance for other projects to attract investors who may be concerned about the risks associated with undertaking the development of green infrastructure. While there is no single recipe for success, especially given the context-specific nature of green infrastructure, there are universal elements, such as measuring and clearly communicating social benefits like increased property values that can help any project access broader funding sources and achieve success.

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Green Infrastructure

Innovative Financing

Case Studies

Examples & Benefits

Looking Ahead

Despite these challenges, many cities around the world have achieved success in installing green infrastructure systems. These implementers have used different strategies to make these projects a reality. In an effort to compile these examples, researchers at Water in the West and ReNUWIt have identified innovative financing approaches being used in the US. By documenting these efforts through a peer-to-peer learning tool (Figure 5), the hope is to help project implementers connect and explore the possibilities of doing things differently.

Figure 5: The Living Map, created by Newsha Ajami, who directs the Urban Water Program at Water in the West, and her team highlights successful innovative water financing efforts around the country designed to be implemented at various scales. The case studies feature a wide variety of mechanisms; for example, some are market-based systems like credit and permit trading used to implement green infrastructure projects built to manage stormwater runoff. *See*: https://localwitw.stanford.edu/programs/urban-water.

Conclusion

Bringing green infrastructure into the mainstream is challenging; however, collaborative and interdisciplinary research efforts like those being conducted here at Stanford are one promising path around the barriers that exist, including scalability and funding. Our hope is that as the number of examples showing how green infrastructure can be used to generate multi-sector benefits increases, more cities will see these natural systems as a viable alternative and in some cases complementary to traditional gray-infrastructure approaches. In turn, this leverages greater opportunities for collaborative funding to implement win-win solutions for people, the environment and the economy.

For Additional Information:
Bea Gordon, Stanford Water in the West Program, 307/ 620-5020 or bigordon@Stanford.edu

Bea Gordon is a hydrologist by training who works as a research analyst and supports communication efforts for Water in the West. Her interest lies in the intersection of hydrology, water policy, and impacted communities — particularly agricultural ones — in the western US. Bea's previous work spans across some of the West's largest water users from agriculture to upstream oil and gas development. More recently, she conducted research for the Wyoming Center for Environmental Hydrology and Geophysics with a focus on irrigation, evapotranspiration, and agricultural water use efficiency. Bea received her BA in Stanford University and her MS from the University of Wyoming where she was a 2015-2016 Mary Mead Fellow for Women in Agriculture and a 2016 Outstanding MS Student in the College of Agriculture. Bea was raised on a cattle ranch in northeastern Wyoming.

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WATER BRIEFS

TRIBAL GROUNDWATER US

AGUA CALIENTE LAWSUIT: REVERSAL URGED BY US DOJ

The United States Department of Justice (DOJ) filed a Motion to Reconsider an Order issued on April 19, 2019, that was a setback for the Agua Caliente Band of Cahuilla Indians in the tribes' long-running lawsuit against two water districts in the Coachella Valley, the Desert Water Agency and the Coachella Valley Water District. The DOJ motion "urges the Court to reconsider its…ruling that the United States and Agua Caliente Band of Cahuilla Indians ('Tribe') lack standing to seek declaration of their disputed federal reserved water rights in this quiet title-type case. In particular, the United States urges the Court to reconsider its ruling on the plaintiffs' standing for three reasons. First, the ruling failed to consider material facts that support the plaintiffs' standing. Second, the ruling misapplied standing doctrine and reached the wrong conclusion. Third, the Court did not allow the United States to present evidence concerning the scope of its water rights claims, pertinent to the Court's standing analysis, which the United States now proffers." *Motion to Reconsider* at 1.

The material facts to support standing were laid out by DOJ's motion: "…the defendants are charging lessees money to utilize the Agua Caliente water right that the plaintiffs seek to quantify. Additionally, the order overlooked that the defendants — by pumping water from the Tribe's overdrafted water supply — have forced the tribe into a dilemma that is an injury-in-fact for standing purposes. The order also overlooked that the defendants dispute that the United States and Tribe possess any reserved right to groundwater, and that this dispute over federal real property injures the plaintiffs and gives them standing to seek declaratory relief in a quiet title-type action." *Id*. at 2.

DOJ asserted that the ruling misapplied law to the facts that it considered in at least three ways: "First, the ruling implied that the plaintiffs' Phase I victory deprived the United States of part of its standing to seek declaration of the right that it seeks to quantify. Second, the ruling incorrectly relied on an out-of-circuit, takings decision that actually supports the plaintiffs' standing in this case. Third, the standing ruling threatens absurd results." *Id*. at 14-15. In regard to "absurd results" DOJ argues that, "[T]his unprecedented standard threatens the absurd consequence that Indian tribes with unquantified Winters rights cannot quantify those rights — establishing in the only conclusive way available the amount of water that is sufficient to fulfill the purposes of the Reservation — until they can first show that they are not able to access sufficient water." *Id*. at 19-20.

In regard to the third issue DOJ raised — failing to present evidence concerning the scope of its water rights claims — DOJ argues the US was "wrongly faulted" for the alleged failure. "The Court's April 19 standing ruling faults the United States for failing to 'provide evidence of harm to the Tribe's federally reserved right.'…Yet the Court never gave the United States an opportunity to submit any such evidence. Rather, consistent with the focus of Phase II (affirmative defenses), the Court restricted claims and factual discovery concerning quantification and a possible violation of the U.S.'s right to Phase III. …The Court also repeatedly prohibited submissions, and warned parties not to deviate from the Court's orders." *Id.* at 21-22 (citations omitted).

The DOJ also made its "Proffer of Evidence" and noted, "[T]he proffer shows that the United States at this time claims that the Agua Caliente Indian Reservation needs at least 33,000 acre-feet of water per year to fully effectuate its primary purpose as a home for an agrarian society. The majority of this water, over 26,000 acre-feet per year, is necessary to irrigate historically and practicably irrigable acreage on the reservation, thus fulfilling the agrarian purpose of the reservation. The total estimate also encompasses over 7,000 acre-feet to serve estimated domestic, commercial, municipal and industrial purposes on the reservation, thus fulfilling the homeland purpose of the reservation." *Id*. at 24.

DOJ then maintained that the record demonstrates the plaintiffs' standing and in addition "…the proffered evidence further highlights the incompatibility of the defendants' continued conduct and the Agua Caliente Reservation, and is pertinent to the Court's view of what is required to demonstrate standing. Specifically, if the defendants are correct in asserting that 'the natural sustainable yield of the Indio Subbasin…averages roughly 26,300 af [acre-feet] per annum,' then the proffered evidence shows that the United States claims more than the entire sustainable yield of the Indio Subbasin for the Agua Caliente Reservation as the Tribe's federal reserved water right." *Id*. at 24. This factual question is critical for the Tribe since "…the proffered evidence, which the Court prevented the plaintiff from filing in Phase II, demonstrates that there is not enough water available to satisfy the needs of both the Tribe and the defendants." *Id*. at 25.

A hearing is scheduled on the DOJ's Motion for Reconsideration on August 19 in US District Court in Riverside, California.

For info: DOJ Motion available at:
www.documentcloud.org/documents/6207654-Litigation.html#document/p1/a513640

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WATER BRIEFS

CWA REGULATION US MAUI GROUNDWATER RULING SUPREME COURT TO HEAR ARGUMENTS

The US Supreme Court (Supreme Court) has scheduled oral argument for November 6th in *Hawai'i Wildlife Fund, et al., v. County of Maui*, Case No. 18-260, on appeal from the 9th Circuit. The case will evaluate whether the County of Maui's wastewater, which is injected into groundwater that ultimately flows into the Pacific Ocean, should be regulated under the Clean Water Act.

A 14-state coalition has filed an amicus brief (friend of the court brief) urging the Supreme Court to uphold the 9th Circuit Court of Appeals' decision, which requires Clean Water Act permits for indirect discharges of pollutants into waters of the United States from a point source through groundwater or any other conduit. The amicus brief was submitted by California Attorney General Xavier Becerra in support of the plaintiffs' (environmental groups') position that the indirect discharge of wastewater into the Pacific Ocean or any other waters of the United States, through groundwater or another similar conduit, is prohibited by the Clean Water Act.

The Attorneys General assert that rejecting the 9th Circuit's decision would not adequately protect the nation's waters and may encourage polluters to discharge pollutants into groundwater that is connected to a creek, river, lake, or ocean in order to avoid Clean Water Act requirements. The state coalition also points out that the position advanced by the County of Maui — and supported by several states, numerous other entities, and the US Environmental Protection Agency (EPA) — is inconsistent with the EPA's longstanding interpretation and application of Clean Water Act requirements. Attorney General Becerra joins the Attorneys General of Maryland, Connecticut, Illinois, Massachusetts, Maine, Michigan, New Jersey, New Mexico, Oregon, Rhode Island, Vermont, Washington, and the District of Columbia in filing the amicus brief.

"This case is not about harnessing the Clean Water Act to regulate groundwater pollution, a subject that is largely a matter of traditional state regulation. Rather, it is about regulating pollution in navigable waters, where that pollution is traceable from a defined point source — the indisputable subject of national regulation under the Clean Water Act." *Amicus Brief* at 1.

"Reversing the court of appeals' decision, or creating a Clean Water Act exception for point source discharges that pass through groundwater or other conduits before reaching navigable waters, would be incongruous with the Act's text and purposes alike. Not only would such an exception threaten the quality of navigable waters that receive discharges of pollutants from point sources via groundwater, it would give polluters an incentive to skirt Clean Water Act regulation simply by relocating point source discharges of pollution to nearby groundwater." *Id*. at 1-2.

The state coalition set out what it believes should be the standard for such an indirect discharge. "The Amici States urge the Court to affirm the court of appeals' decision and hold that, where pollutants are fairly traceable from a point source to navigable waters through groundwater or other conduits, the underlying point source discharge falls within the scope of the Clean Water Act's NPDES program." *Id*. at 2.

For info: Amicus Brief is available at: https://oag.ca.gov/system/files/attachments/press-docs/18-260%20Maryland%20et%20al%20amicus%20brief.pdf

COAL ASH SAFEGUARDS US PROTECTIONS REMOVAL

On July 30, the US Environmental Protection Agency (EPA) accelerated its ongoing effort to gut landmark safeguards that protect public health and the environment from toxic coal ash pollution by weakening safeguards for coal ash piles and sites where coal ash is placed on or beneath the ground, according to a press release by Earthjustice. Proposed for removal are federal safeguards for coal ash waste piles and construction projects that use ash as fill. The Trump administration's proposal, which comes in response to industry requests, exempts coal ash waste piles — often non-containerized waste placed on land — from regulatory safeguards designed to protect public health.

Earthjustice also noted that the proposed Trump administration change encourages greater use of toxic coal ash, as a cheap alternative to soil as a filler in construction and landscaping, by removing all volume restrictions for such waste projects. The proposal allows projects where coal ash is placed on land for any purpose, usually without barriers, to contain unlimited volumes of coal ash and subjects users to completing safety demonstrations only when coal ash is placed in inherently dangerous areas, such as within five feet of groundwater, in floodplains, and over sinkholes. There is no required notification to the public that such projects are occurring and no requirement to share demonstrations with the public unless directly asked.

EPA, meanwhile, stated that it "is proposing further amendments to the regulations governing the disposal of coal combustion residuals, commonly known as coal ash. This proposal is the first of three planned revisions to address matters raised in litigation, legislation, petitions for reconsideration and rule implementation. "Today the Agency is proposing sensible changes that will improve the coal ash regulations and continue to encourage appropriate beneficial use,' said EPA Administrator Andrew Wheeler. 'These proposed changes will further responsible management of coal ash while protecting human health and the environment.'"

EPA's press release referred to two issues remanded back to EPA for action: "EPA is proposing a modification to one of the criteria used to determine if coal ash is being beneficially used or would be considered disposal. Currently, when 12,400 tons or more of unencapsulated coal ash will be placed on the land in non-roadway applications, the user must perform an environmental demonstration. EPA is proposing to replace the numerical threshold for triggering an environmental demonstration with location-based criteria (e.g., placement in an unstable area, wetland, floodplain, fault area or seismic zone) derived from the existing requirements in the 2015 coal ash final rule. The second proposed change is to the requirements for managing piles of coal ash. Currently, there are different requirements for piles depending on whether the pile is on-site at for example an electric utility or off-site for beneficial use. The proposal would establish a single approach, which

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would apply to all temporary placement of unencapsulated coal ash on the land, regardless of whether a pile is on-site or off-site, and regardless of whether the coal ash in the pile is destined for beneficial use or disposal."

EPA is soliciting comments and information related to the proposed provisions, alternative approaches to these proposed provisions, and other considerations outlined in the notice. The comment period will be open for 60 days, during which a public hearing will be held for interested persons to present information, comments or views concerning these proposed changes.
For info: EPA website at: www.epa.gov/coalash; Lisa Evans, Earthjustice, 781/ 631-4119 or https://earthjustice.org/news

DROUGHT MANAGEMENT OR POLICY RESPONSES

The main stem of the Willamette River flows north for 187 miles between the Oregon Coast Range and Cascade Range. Northwestern Oregon's three largest cities — Portland, Salem and Eugene — are located in the basin. In the fertile Willamette River Basin, where two-thirds of the state's population lives, managing water scarcity would be more effective if conservation measures were introduced in advance and upstream from the locations where droughts are likely to cause shortages, according to a new study. Published July 15, "Scope and limitations of drought management within complex human–natural systems"employs a detailed model of the Willamette River Basin in Oregon to evaluate the effectiveness of a variety of potential drought policy interventions to conserve or reallocate water during a simulated near-term "drought year." The drought year is characterized by early-season low flows that make it impossible to meet water demands. The results indicate that while the policies are effective at conserving water, they have limited ability to mitigate the shortages because the timing and location of conservation responses do not match the timing and location of the shortages.

Growing evidence suggests that drought risk is increasing due to climate change. Evaluation of potential policy responses involves understanding complex economic tradeoffs, hydrologic and social feedbacks, and recognizing how combinations of interventions may have complementary or conflicting effects. This paper explores the potential that coupled human–natural system models have to address these questions.

For the study — led by Oregon State University economist William Jaeger — Adell Amos, the UO's Clayton R. Hess Professor of Law and associate dean for academic affairs in the UO School of Law, focused on the integration of water law and policy for comprehensive modeling that pulls from both human and natural systems. Co-authors are David R. Conklin of Oregon Freshwater Simulations in Portland; Christian Langpap of Oregon State University; Kathleen Moore of the University of Washington, Seattle; and Andrew J. Plantinga of the University of California, Santa Barbara.
For info: Study available at Nature Sustainability website: www.nature.com/articles/s41893-019-0326-y

PUMPING OVERDRAFT CA EFFECTS & POLICIES

Groundwater overdraft has been a growing problem for California for decades. This overdraft is predominantly driven by the economic value of water for agricultural production and cities. Spurred by the recent drought, California passed legislation requiring the elimination of groundwater overdraft by 2040.

To explore potential water supply effects of ending long-term groundwater overdraft in California's Central Valley, the paper compares several water policies with historical and warmer–drier climates, employing a statewide hydroeconomic optimization model, CALVIN. [CALVIN at: https://watershed.ucdavis.edu/shed/lund/CALVIN/]. Hydro-economic optimization models like CALVIN allocate water to agricultural and urban users considering hydrologic conditions, infrastructure, and environmental restrictions among other factors, such that systemwide water scarcity and operation costs are minimized. *Statewide Effects of Ending Long-Term Groundwater Overdraft in California*, Mustafa S. Dogan, S.M.ASCE; Ian Buck; Josue Medellin-Azuara, M.ASCE; and Jay R. Lund, Dist. M.ASCE, published online 6/28/2019.

The model minimizes agricultural, urban scarcity, and operating costs over 82 years of historical hydrologic variability, given today's infrastructure and environmental flow constraints. The model results assess effects of overdraft and Delta policies for different climates on water deliveries, economic costs, environmental flows, water market operations, and the economic value of expanding infrastructure capacities.

Prohibiting long-term overdraft leads to reduced agricultural water use and operations, and reduced outflows to the sea from the Sacramento-San Joaquin Delta, where water availability policies become important. In combination with a warmer–drier climate, ending overdraft further exacerbates water scarcities, increases environmental and economic costs, and increases the marginal economic value of water exports from the Delta, which are likely to worsen water conflicts and illustrate connections of California's groundwater and surface water problems.

Economically useful adaptation actions include: more water transfers involving the Delta; water markets and trades; conjunctive use of surface water and groundwater; and recycled wastewater for coastal urban users.
For info: Paper available at: https://ascelibrary.org/doi/10.1061/%28ASCE%29WR.1943-5452.0001096

CYBERSECURITY GUIDE US WATER & WASTEWATER

Water and wastewater utilities provide critical lifeline services to their communities and their regions. Supporting these vitally important functions requires secure **i**nformation **t**echnology (IT) and **o**perational **t**echnology (OT), yet the sector's IT and OT networks continue to face an onslaught of threats from cyber criminals, nation states, and others. To support the sector in its cybersecurity goals, and in response to the continually evolving threats, WaterISAC, the Water Information Sharing and Analysis Center, has just published a newly updated resource: "*15 Cybersecurity Fundamentals for Water and Wastewater Utilities*."

The updated guide contains dozens of best practices, grouped into 15 main categories, that water and

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WATER BRIEFS

wastewater systems can implement to reduce security risks to their IT and OT systems. Each recommendation is accompanied by links to corresponding technical resources. In sum, the guide connects users to the information and tools needed to take a dive deep into this important issue.
For info: www.waterisac.org

PURIFICATION RESEARCH US RECLAMATION GRANTS

The US Bureau of Reclamation (Reclamation) announced in July that 30 projects will receive $5.1 million from the Desalination and Water Purification Research Program to develop improved and inexpensive ways to desalinate and treat impaired water.

Grants are being awarded to a diverse group of projects to reduce the cost, energy consumption, and environmental impacts of treating impaired or otherwise unusable water for use by local communities.

Twenty-five awards are for laboratory-scale projects — typically bench scale studies involving small flow rates. They are used to determine the viability of a novel process, new materials or process modifications. Awards are limited to $150,000.

Five projects are selected as pilot-scale proposals, which test a novel process at a sufficiently large-scale to determine the technical, practical and economic viability of the process. Awards are limited to $400,000 and no more than $200,000 per year.

Types of projects funded include modeling, testing new materials such as nanomaterials, and improvements on known technologies such as distillation and electrodialysis. Projects are funded in the following states: Alabama, Florida, Massachusetts, Oklahoma, Arizona, Georgia, New Jersey, Texas, California, Hawaii, New Mexico, Pennsylvania, Colorado, Illinois, New York, and Virginia.
For info: Details on each project is available at www.usbr.gov/research/dwpr.

PFAS TASK FORCE US DEFENSE DEPARTMENT DIRECTIVE

Dr. Mark Esper, the new US Secretary of Defense has launched a PFAS (polyfluorinated and perfluorinated substances) task force. The Department of Defense (DoD) oversees active and closed military installations. Over 400 military installations are known to be contaminated with PFAS. In many cases, this contamination is moving into drinking water supplies, groundwater, and surface water. *See* Kray, *TWR* #182.

"The Department is committed to taking a strong and proactive stance to address the effects arising out of any releases of these substances from all defense activities including the National Guard and Reserves," according to a Pentagon Directive Esper wrote on his July 23rd swearing-in day.

According to Esper's Directive, the following are key focus areas for the Task Force: Health Aspects; Cleanup Standards and Performance; Finding and Funding an Effective Substitute Firefighting Foam Without PFAS; Science-Supported Standards for Exposure and Cleanup; Interagency Coordination; and Public/Congress Perceptions of DoD's Effort.

The PFAS Task Force is to report on its composition and charter within 30 days of the Directive and provide an update within 180 days, Esper wrote.

The nonprofit Environmental Working Group (EWG) has identified and mapped 206 military sites in the US where drinking water or groundwater is contaminated with PFAS, at levels that exceed the Environmental Protection Agency's health guideline. EWG considers this "only the tip of a toxic iceberg that is largely hidden and still growing."
For info: EWG website: www.ewg.org/research/pfas-chemicals-contaminate-us-military-sites

NONPOINT PROJECTS WY EPA GRANTS

The US Environmental Protection Agency (EPA) has awarded $859,000 to the Wyoming Department of Environmental Quality (WDEQ) to help protect human health and the environment through a Nonpoint Source Program (NPS) Clean Water Act Section 319 grant. This grant is given to states to implement environmental programs that address nonpoint source pollution in surface and groundwater to meet and maintain water quality standards. EPA is partnering with WDEQ to restore water quality by focusing on one of the nation's largest remaining causes of surface water impairment — contaminated runoff from nonpoint sources.

Under this program, a total of eight proposals were selected for funding that will include watershed planning and implementation projects; stream restoration and livestock impact practices; sediment reduction and monitoring; aquatic habitat improvements; and information and education projects. The program works through a set of overarching principles that emphasize voluntary and incentive-based participation, locally-led projects, partnerships, measurable water quality improvement, and effective and efficient program administration. For more information on Wyoming's NPS accomplishments for 2018 visit: https://arcg.is/18SG5S.

Nonpoint sources of pollution continue to be recognized as the nation's largest remaining cause of surface water quality impairments. The effects of nonpoint source pollution can be seen within the lakes, streams and rivers of Wyoming. The three nonpoint source pollutants causing the majority of Wyoming's surface water quality impairments are pathogens, sediment and selenium.

Nonpoint source pollution encompasses a wide range of sources that are not subject to federal or often state regulation. These sources include agricultural runoff, unpermitted urban runoff, abandoned mine drainage, failing onsite disposal systems, and pollution caused by changes to natural stream channels. Congress enacted Section 319 of the Clean Water Act in 1987, establishing a national program to control nonpoint sources of water pollution. Through Section 319, EPA provides states, territories, and tribes with guidance and grant funding to implement their nonpoint source programs and to support local watershed projects to improve water quality. Hundreds of additional projects are underway across the country. Information on additional successful nonpoint source projects is available at: www.epa.gov/nps/nonpoint-source-success-stories
For info: Lisa McClain-Vanderpool, EPA, 303/ 312-6077 or mcclain-vanderpool.lisa@epa.gov

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CALENDAR

August 13-15 CA
Indian Reserved Water Rights Claims Symposium, Funner. Harrah's Resort Southern Caflifornia. Presented by the Native American Rights Fund & Western States Water Council. For info: www.narf.org/cases/water-rights-symposium/

August 15-16 WA
Water Law in Central Washington Seminar, Ellensburg. Central Washington University, 400 E. University Way. For info: The Seminar Group, 800/ 574-4852, info@theseminargroup.net or www.theseminargroup.net

August 19 CA & WEB
Industrial Stormwater General Permit 2018 Amendments - Public Training Workshop, Sacramento. CalEPA Headquarters Bldg., Byron Sher Auditorium, 1001 I Street. Presented by State Water Resources Water Boards, 9 a.m. - Noon. For info: Laurel Warddrip, 916/ 341-5531 or Laurel.Warddrip@waterboards.ca.gov

August 19-22 OR
Oregon Assoc. of Water Utilities Summer Classic Conference, Seaside. Seaside Convention Center. For info: https://oawu.net/training-events/annual-summer-classic-conference-seaside/

August 20 CA
Central Valley Drinking Water - Solutions to Groundwater Contamination Workshop, Fresno. Center for Irrigation Technology - Conference Room, 5370 N. Chestnut Avenue. Presented by the American Ground Water Trust & Fresno State Califronia Water Institute. For info: www.agwt.org/events

August 20-22 CO
Colorado Water Congress Summer Conference & Membership Meeting, Steamboat Springs. Steamboat Grand. For info: www.cowatercongress.org/summer-conference.html

August 20-22 TX
8th Annual Texas Groundwater Summit, San Antonio. Hyatt Regency Hill Country Resort. Presented by Texas Alliance of Groundwater Districts. For info: https://texasgroundwater.org

August 21 CA
Central Valley Drinking Water - Solutions to Groundwater Contamination Workshop, Bakersfield. DoubleTree by Hilton Bakersfield, 3100 Camino Del Rio Court. Presented by the American Ground Water Trust & Fresno State California Water Institute. For info: www.agwt.org/events

August 22 CA
Fourth Annual Water Data Summit: "How Big Data Can Power California to a Better Water Future", Davis. UC Davis. Presented by California Data Collaborative. For info: www.cawaterdatasummit.org/

August 21-22 DC
Water Finance Conference, Washington. Washington Court Hotel. Hosted by Water Finance & Management. For info: https://waterfm.com/call-speakers-2019-water-finance-conference/

August 22-23 FL
Land Use Law Conference, Tampa. Sheraton Riverwalk. For info: CLE Int'l, 800/ 873-7130, live@cle.com or www.cle.com

August 27-29 CA
Edge of Drought Tour, Burbank. Southern Central Coast. Presented by Water Education Foundation. For info: www.watereducation.org/tour/edge-drought-tour

August 28 CA
Industrial Stormwater General Permit 2018 Amendments - Public Training Workshop, Playa Del Ray. Environmental Learning Center at Hyperion Auditorium, 12000 Vista Del Mar. Presented by State Water Resources Water Boards, 9 a.m. - Noon. For info: Laurel Warddrip, 916/ 341-5531 or Laurel.Warddrip@waterboards.ca.gov

September 3-5 Mexico
Aquatech Mexico 2019 Trade Show, Mexico City. WTC Mexico City, Montecito 38. For info: www.aquatechtrade.com/mexico/

September 8-11 CA
34th Annual WateReuse Symposium, San Diego. Marriott Marquis. For info: https://watereuse.org/news-events/

September 8-11 OR
PNCWA 2019: Building Professional Excellence in Water Quality - Annual Conference & Exhibition, Portland. Oregon Convention Center. Presented by the Pacific Northwest Clean Water Assoc. For info: https://pcwm.memberclicks.net/

September 9-11 TN
WaterPro Conference, Nashville. Gaylord Opryland Resort & Convention Center. Presented by National Rural Water Association. For info: https://waterproconference.org

September 10 CA
Incentivizing Groundwater Recharge: A Berkeley Law Symposium, Berkeley. UC Berkeley, 8:30 am - 5:30 pm. Hosted by Center for Law, Energy & the Environment; Registration Closes August 27. For info: https://sites.law.berkeley.edu/recharge-2019/

September 10 WA
Water Quality Management in Washington Seminar, Seattle, Crowne Plaza Hotel. For info: Law Seminars International, 206/ 567-4490 or www.lawseminars.com/

September 11 OR
EPA Portland Harbor Public Forum, Portland. TBA. Evening Forum with ODEQ & Community Advisory Group Support. For info: Laura Knudsen, 206/ 553-1838 or knudsen.laura@epa.gov

September 11-14 CA
Association of Water Technologies Annual Convention & Exhibition, Palm Springs. Palm Springs Convention Center. For info: www.awt.org/annualconvention19/

September 12 WA
Advanced Superfund Conference: CERCLA/MTCA/Sediment Remediation - 20th Annual, Seattle. Washington Convention Center. For info: Holly Duncan, 503/ 282-5220, hduncan@elecenter.com or www.elecenter.com

September 12-13 CO
Advanced Metering Infrastructure (AMI) for Water Utilities Conference, Denver. EUCI Office Bldg. Conference Center, 4601 DTC Blvd., B-100. For info: www.euci.com/event

September 12-14 BC
Columbia Basin Transboundary Conference: One River, One Future - 6th International Columbia River Transboundary Conference, Kimberly. Kimberly Conference Center. RE: Renegotiation of the Columbia River Treaty, Reintroduction of Salmon to the Columbia River above Grand Coulee Dam in Washington & British Columbia & More. For info: Caitlin Hinton, Columbia Basin Trust, 250/ 344-2445 or chinton@cbt.org or https://transboundaryriverconference.org

September 16-17 Alberta
4th Annual Canadian Shale Water Management 2019: Reducing the Cost of Water Recycling & Reuse Summit, Calgary. TBD. Presented by IQ Hub. For info: www.canada.shale-water-management.com

September 16-18 China
American Water Resources Assoc. International Conference, Beijing. Joint AWRA-Chinese Academy of Sciences Event. RE: New Technologies, Strategies, Policies & Institutions. For info: www.awra.org

September 16-19 CO
Water Information Management Systems (WIMS) Workshop & USGS Water Use Collaboration, Fort Collins. Hilton Fort Collins. Presented by Western States Water Council & USGS. For info: http://www.westernstateswater.org/upcoming-meetings/

September 17-18 MT
Montana Water Law Seminar, Helena. Best Western Great Northernn Hotel. For info: The Seminar Group, 800/ 574-4852, info@theseminargroup.net or www.theseminargroup.net

September 18 CA
Industrial Stormwater General Permit 2018 Amendments - Public Training Workshop, Riverside. Santa Ana Regional Water Quality Control Board, 3737 Main Street, Ste. 500, Highgrove Room. Presented by State Water Resources Control Board, 9 a.m. - Noon. For info: Laurel Warddrip, 916/ 341-5531 or Laurel.Warddrip@waterboards.ca.gov

September 18-20 TX
One Water Summit: Sustainable, Integrated Water Management, Austin. JW Marriott Hotel. For info: http://uswateralliance.org/summit/

September 19-20 TX
Texas Water Law Conference, San Antonio. La Cantera Hill Country Resort. For info: CLE Int'l, 800/ 873-7130, live@cle.com or www.cle.com

September 19-20 WA
Tribal Water in the Pacific Northwest Seminar, Seattle. Crowne Plaza Hotel. For info: Law Seminars International, 206/ 567-4490 or www.lawseminars.com/

September 21-25 IL
WEFTEC 2019: The Water Quality Event & Exhibition, Chicago. McCormick Place. Presented by Water Education Foundation. For info: www.weftec.org/future-weftec-schedule/

September 26 OR
Long Tom Watershed Council Annual Celebration, Monroe. Hazel Dell Road; 5-8 pm. Presented by the Long Tom Watershed Council. For info: www.longtom.org/annualcelebration2019/

September 26-27 AZ
Tribal Water Law Conference, Scottsdale. Hilton Resort & Villas. For info: CLE Int'l, 800/ 873-7130, live@cle.com or www.cle.com

September 30-Oct. 1 FL
Managing Florida's Aquifers 19th Annual Conference, Orlando. Florida Hotel & Conference Center. Presented by the American Ground Water Trust. For info: www.agwt.org/events

October 1 WA
"Water Resources Planning & Implementation: Challenges, Complexity, and Uncertainty" - American Water Resources Assoc.-WA State Conference, Seattle. Mountaineers Seattle Program Center, 7700 Sand Point Way NE. Presented by the Washington Section of American Water Resources Assoc. For info: WA Section, 206/ 838-6299 or admin@waawra.org

October 2-3 WA
GreenTech 2019: Innovating Environmental Protection for the Future Conference, Seattle. Bell Harbor International Conference Center. Presented by Environmental Law Institute. For info: greentechconference.org

October 2-4 NV
WaterSmart Innovations Conference & Exposition, Las Vegas. South Point Exhibition Hall. For info: https://watersmartinnovations.com/index.php

October 3 OR
Environmental Year in Review CLE, Troutdale. McMenamins Edgefield Manor. Presented by Environmental & Natural Resources Section Oregon BAR. For info: https://ebiz.osbar.org/ebusiness/Meetings/Meeting.aspx?ID=2469

October 3 WA
Northwest Remediation Conference: Cleanup/Reuse of Contaminated Properties, Tacoma. Greater Tacoma Convention Center. Presented by Northwest Environmental Business Council and Washington Dept of Ecology. For info: https://nwremediation.com

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CALENDAR

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October 3 WA
Hydropower Relicensing Seminar, Seattle. Washington Athletic Club, 1325 6th Avenue. For info: The Seminar Group, 800/ 574-4852, info@theseminargroup.net or www.theseminargroup.net

October 3-4 NM
New Mexico Water Law Conference, Santa Fe. Eldorado Hotel & Spa. For info: CLE Int'l, 800/ 873-7130, live@cle.com or www.cle.com

October 3-4 NM
Cultural Resources Law Conference, Santa Fe. Eldorado Hotel & Spa. For info: CLE Int'l, 800/ 873-7130, live@cle.com or www.cle.com

October 4 WA
Navigating Floodplains & Flood Risk Seminar, Seattle. Washington Athletic Club, 1325 6th Avenue. For info: The Seminar Group, 800/ 574-4852, info@theseminargroup.net or www.theseminargroup.net

October 6-9 CA
Stormwater…Why We Do What We Do - CASQA 2019 Fifteenth Annual Conference, Monterey. Monterey Conference Center. Presented by the California Stormwater Quality Assoc. For info: www.CASQA.org

October 7 UT
Utah Water Law Conference, Salt Lake City, Marriott University Park. For info: www.cle.com

October 7-10 OR
Oregon Association of Water Utilities Fall Operators Conference, Florence, Florence Events Center. For info: https://oawu.net/training-events/training-courses/

October 7-11 NC
Water & Health: Where Science Meets Policy Conference, Chapel Hill. Friday Conference Center. Presented by UNC Water Institute. For info: https://waterinstitute.unc.edu/conferences/waterandhealth2019/

October 8-10 AL
Interstate Council on Water Policy 60th Annual Meeting, Mobile. Renaissance Hotel Downtown. For info: Sue Lowry, ICWP, 307/ 630-5804, Sue.ICWP@gmail.com or www.icwp.org

October 8-10 TX
Autumn Environmental Conference & Expo, Austin. Palmer Events Center, 900 Barton Springs Road. Presented by TCEQ. For info: www.tceq.texas.gov/p2/events/autumn-environmental-conference-and-expo

October 17 CA
Association of California Water Agencies Annual Regulatory Summit: "Riding the Regulatory Wave in California", Sacramento. Hilton Sacramento Arden West. For info: www.acwa.com/events/

October 17-20 CA
27th Annual Environmental Law Conference at Yosemite, Yosemite. Tenaya Lodge. Presented by the California Lawyers Assoc. For info: https://calawyers.org/Yosemite

2019 AWRA Washington Annual State Conference
October 1, 2019
Seattle, WA
AWRA American Water Resources Association Washington Section
Water Resources Planning and Implementation:
Challenges, Complexity, and Uncertainty

Photos by Tom Ring
Details and Registration at: www.waawra.org