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Water Rights, Water Quality & Water Solutions in the West

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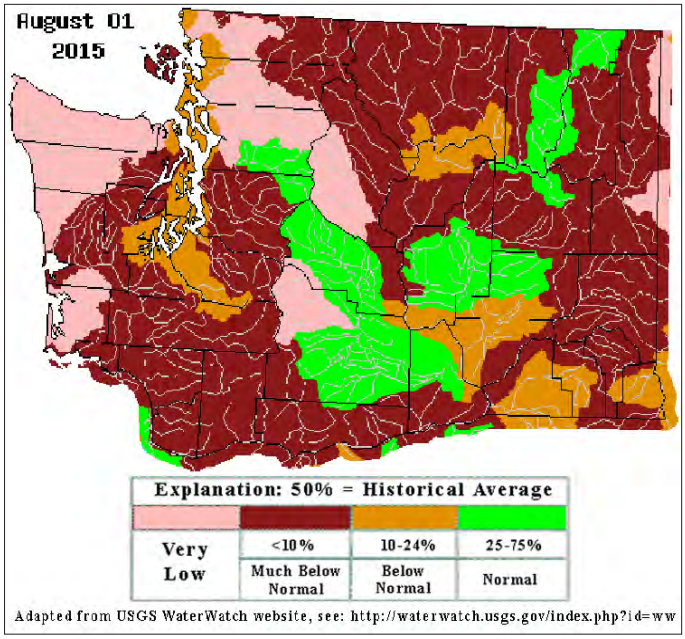
FLOW RESTORATION DURING SEVERE DROUGHT

WASHINGTON ENTERS UNCHARTED TERRITORY

by Amanda E. Cronin, Washington Water Trust (Seattle, WA)

INTRODUCTION

In 2015, Washington State ski resorts had abbreviated seasons, or in some instances no season at all, resulting in significant negative economic impacts throughout the industry. This also signaled a dire year for instream and out of stream water supply. Lower than average snowfall, the highest temperatures on record for October-March (4.7 Fahrenheit higher than normal), and near average precipitation (which fell as rain rather than snow) in Western Washington combined to drive the state towards a water season arguably without precedent. Over the winter of 2014-2015, the State received historically low snowpack in both the Cascade and Olympic Mountain ranges. Snowpack was listed as 3% of normal in the Dungeness, 5% in the Upper Yakima, 28% in the Lower Yakima, and 5% in the Central Puget Sound on April 1, 2015. Unlike 2014, spring snow events did not arrive. On May 15, 2015, in response to what is likely the most severe drought in State history Washington State Governor Jay Inslee declared a statewide drought emergency. Subsequently, the summer of 2015 has been Washington State's hottest on record, with multiple locations throughout the state breaking records in May, June, and July for high temperatures and low rainfall. As of August 2015, the US Drought Monitor classified nearly 43 percent of the state as being under "extreme" drought conditions, while the other 58 percent was labeled a "severe drought." These problems persisted through August.



Adapted from USGS WaterWatch website, see: http://waterwatch.usgs.gov/index.php?id=ww

The continuing severity of drought conditions has brought Washington into "uncharted territory" as concerns effective drought response. Current El Nino models offer little hope of near-term relief — predicting a continued pattern of warmer and drier conditions over the next six months. The severity of the problem is illustrated by the USGS in Figure 1, which depicts average streamflows on August 1st 2015 across the state.

Drought & Streamflow

Market Approach

Restoration Options

Competitive Bidding

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Washington Water Trust (WWT) — a non-profit organization with a mission to restore stream flow to benefit fisheries, water quality, recreation, and agriculture — has been working throughout the summer of 2015 to respond to this crisis. WWT utilizes voluntary, market-based approaches to lease and purchase water rights and construct a variety of transactions that benefit stream flows (*see* Cronin & Fowler, *TWR* #102). The 2015 drought is a critical test for these types of flow restoration strategies, and the urgency to act was brought into sharp relief for our streams and aquatic wildlife. This article explores the transaction tools available to flow restoration practitioners, details our 2015 drought response, and enumerates some of the lessons learned from that work.

TOOLS FOR DROUGHT RESPONSE

Flow restoration practitioners have developed a diverse set of tools for flow restoration, including: water leases; water purchases; water donations; water use forbearance agreements; pulse flow agreements; source water substitutions; improved irrigation efficiencies; and aquifer recharge. [*See TWR's* Index of Articles: www.thewaterreport.com/ARTICLES.html >> "Instream Flow Water Rights," for additional information]. The most effective flow restoration tools in a drought year are those that can be implemented within a few months. Long delays due to necessary processing by the State agency, time-consuming infrastructure installation, or complicated negotiations are to be avoided. Given these exigencies, leasing programs, some source substitutions, and certain pulse flow agreements are best suited for drought years, because they can be quickly implemented.

Leasing: "Reverse Auctions"

Leasing programs are carefully structured water leasing opportunities for water right holders in a specific time and place. They may take the form of an open solicitation for senior water right holders to lease water at a set price, or prices may be negotiated directly with individuals. "Reverse auctions" are a type of leasing program that allows irrigators to set the price at which they are willing to fallow ground and lease their water to be left instream. Reverse auctions generally attempt to encourage competitive bidding as a set amount of funding for the entire auction is usually disclosed ahead of time. Prices are generally nonnegotiable in a reverse auction, and a reserve price is generally set above which the buyer is unwilling to pay. Reserve prices may or may not be revealed to the participants during or after the auction (Hartwell and Aylward, 2007, "*Auctions and the Reallocation of Water Rights in Central Oregon*"). Any type of leasing program requires the facilitator to determine and publish eligibility, timelines, and expectations for participants.

Source Substitutions

Source substitutions work when river or stream diversions are swapped out for another source that has less of an impact on stream flow. These sources include: groundwater; reclaimed or recycled water; mainstem river water (in lieu of tributary water); or stored water from a reservoir. Source substitutions are an effective drought relief tool when the source of the substitute water is ready and available and its delivery does not require a prohibitive amount of construction or administrative or legal review. Switching to groundwater, in particular, requires a strong understanding of the underlying hydrogeology. A source switch to groundwater from surface water for flow restoration purposes is only effective in situations where the net hydrological effect improves the magnitude, timing, and duration of surface flows during critical low flow periods. WWT completed one source substitution project in 2015 near Sequim, Washington (discussed below).

Pulse Flow Agreements

With pulse flow agreements, the management goal is to release a specific quantity of water at a specific time (as a "pulse") in a targeted stream reach. Pulse flows are particularly effective when stored water is available upstream and can be released *when* the downstream aquatic ecosystem needs it most. These water release agreements are typically achieved by providing incentives to a group of water users to stop or decrease diversions during the critical flow period determined by aquatic biologists and local recovery plans. Pulse flows can be particularly helpful for attracting upstream adult fish migration or assisting downstream juvenile fish migration. The biggest challenges to implementing pulse flows for flow enhancement during drought years are: 1) coordinating and negotiating changes in behavior and irrigation system management with the participating water users; and 2) protecting the flow to ensure that the pulsed water is not diverted by any downstream water user. Achieving timely coordination and negotiation of changes in diversion behavior during biologically significant periods can present a significant obstacle to successful pulse flow agreements.

Drought & Streamflow Relationships

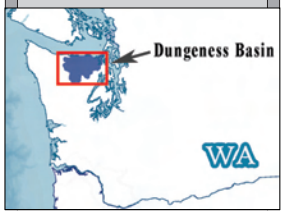
Late Season Flow

Auction Eligibility Conditions

"Reserve Price"

Low Participation

Leasing Program



2015 DROUGHT FLOW ENHANCEMENT RESPONSE

EXPEDITED ACTIONS IN THE YAKIMA & DUNGENESS BASINS

While Washington Water Trust has active flow restoration projects across the State of Washington, our 2015 drought response focused primarily on two basins: the Yakima Basin in eastern Washington; and the Dungeness Basin in western Washington. WWT has been investing significant time in the Yakima and Dungeness basins for some time, and through this active presence has established working relationships with key water managers and stakeholders. Low flow conditions were especially threatening to salmonids in both basins in 2015, and emergency state funding became available which helped increase WWT flow restoration efforts in this water-critical year.

Yakima Basin-2015 Yakima River Tributary Reverse Water Right Auction

WWT has worked in the Yakima Basin since 1998. One (of two) of our statewide offices is in Ellensburg, which is located in the heart of the Basin. The Yakima Basin supports over 600,000 acres of irrigated agriculture. This is more irrigated agriculture than any other watershed in the state, and is punctuated by a network of water resource management partnerships that is among the most complex and sophisticated anywhere in the United States (*see* Garrity & Malloch, *TWR* #135). WWT has completed more than 50 Yakima Basin transactions to date, including 44 leases and eight permanent water right purchases. A focal point of WWT's work has been in upper Yakima basin tributaries, which provide habitat to Endangered Species Act (ESA) listed Steelhead.

WWT's 2015 drought response in the Yakima was a coordinated effort with the Washington Department of Ecology (Ecology). When drought year conditions became apparent due to record low snowpack in March 2015, Ecology, the state water resource management agency, elected to facilitate a reverse auction to secure late season instream flow. Ecology sent out invitations to six hundred and fifty senior water right holders with pre-1905 water rights in fish critical tributaries in the upper Yakima River Basin and above the confluence with the Naches River.

REVERSE AUCTION ELIGIBILITY WAS DETERMINED BY THE FOLLOWING CONDITIONS:

- Priority date of May 10, 1905 or earlier
- Awarded a Conditional Final Order (CFO) in Adjudication;
- Purpose, including irrigation
- Location: point of diversion on Yakima tributary, Naches River, or Tieton, upstream of Yakima
- Previously irrigated acres submitted in bid must be fallowed after bid accepted
- Bidder must demonstrate water use in past five years
- Cooperation with Ecology to transfer bid into Trust Water Rights Program
- Bidder accepts monitoring access to lands during lease

Outreach workshops were held in two locations in early April with bids due to Ecology shortly after these meetings. Ecology also decided not to reveal the "reserve price" — i.e., the price above which they would not pay for leased water. A higher level reserve price was assigned, but not revealed, to water rights from tributaries with higher ecological value. Bids were accepted on a per-acre-of-irrigated-land (per acre) basis. Ecology administered and conducted the outreach for the 2015 Yakima River Tributary Reverse Auction, with an agreement that WWT handle the contracting and court processing for any eligible bids. While six hundred and fifty bid invitations were mailed to water right holders and it was revealed that funding availability totaled $500,000, participation was much lower than expected, with only $59,327 expended on water leasing. Ecology received 10 bids, and of those six were accepted and four were rejected and invited to re-bid; one re-bid was accepted. Two of the accepted bids were pulled due to administrative issues that could not be resolved in time. The combined totals of leased water in the Teanaway River and Big Creek, on a total of 168.2 irrigated acres, amounted to 1.91 **c**ubic **f**eet per **s**econd (cfs) of water flow and 274 acre-feet of water (one acre-foot = water one foot deep covering a one acre area). While participation was considerably higher in the Dungeness basin drought year auction in western Washington, the total funding there was also not exhausted.

Dungeness Basin

Washington Water Trust has been working on stream flow restoration and groundwater mitigation in the Dungeness watershed since 2008. There is a history of water leasing during dry years in the Dungeness with Ecology administering programs in 2001, 2003, 2004 and 2005, and WWT managing a leasing program in 2009. Three years of Ecology water leasing focused on flow restoration for the last 45 days of the irrigation season: August 1st-September 15th. The Ecology program was an open invitation to eligible irrigators, and a price was set on a per acre basis determined by consultation with leaders in the irrigation community. Participation was relatively high with 16-19 irrigators participating annually, with between 7-11 cfs restored to the river each year and a set price of $175/acre (for the 45 day leasing season).

Drought & Streamflow

Price Discovery

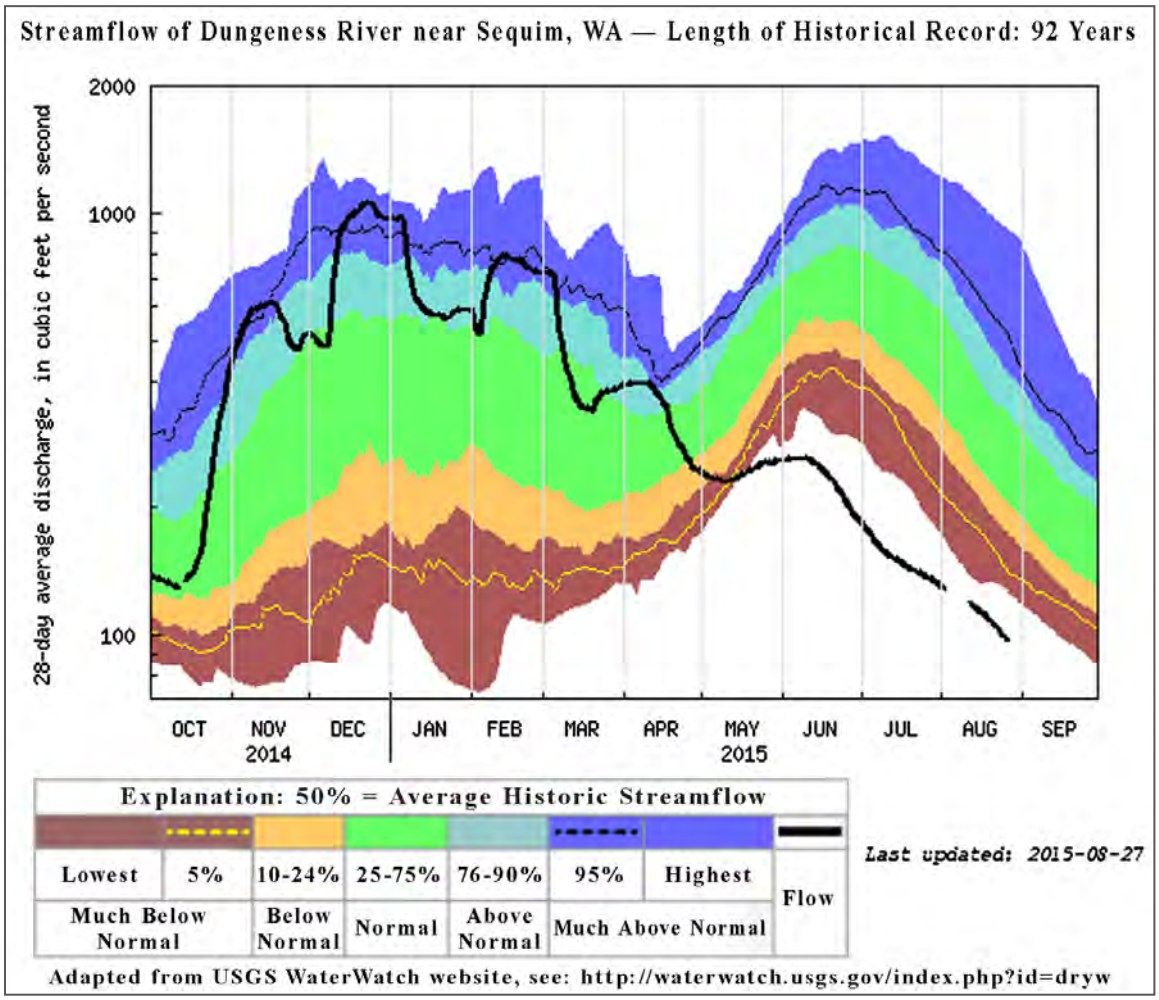
Rain v. Snow

Low Flow Record

Reverse Auction

When hired by Ecology and Clallam County to work in the basin in 2008, WWT opted to run a reverse auction in cooperation with the irrigators with the objective being to determine a market rate for water in the basin (price discovery). WWT's 2009 reverse auction garnered participation from 14 irrigators at an average price of $85/acre-foot and a total of 2.32 cubic feet per second left instream for the last thirty days (August 15-September 15) of the irrigation season. The auction was facilitated in cooperation with the Dungeness Water Users Association, an umbrella group for the seven irrigation districts and companies in the Dungeness watershed. The 2009 program demonstrated that many irrigators in the valley, especially those with smaller acreages, were willing to accept a smaller amount of money per acre for season fallowing (i.e. 30 day fallow period). Snowpack in the Dungeness was not low enough in 2009 to be designated a drought year but summer flows were below average with flow at 106 cfs measured at the mouth of the Dungeness River on August 1st.

This year the snowpack situation in the Dungeness Basin was far more dire, with snowpack failing to exceed ten percent of normal all winter, and bottoming out to zero percent snowpack by late winter and early spring. Although total precipitation was about normal, above average temperatures resulted in precipitation falling as rain rather than snow. Unlike the Yakima Basin, which has four major surface water storage reservoirs, the Dungeness has no water storage. By spring 2015, summer streamflow forecasts were predicted to be the lowest on record. On August 1st of 2015 the flow at the mouth of the Dungeness River was 66.7 cfs as measured at Ecology's gauge, which trumped a previously low flow record of 85 cfs set in 2005 on the same day at the same location. The USGS gauge, which is above the five major irrigation diversions and includes 85 years of data, illustrates the unprecedented nature of this year's stream flow lows (*see* Figure 2). The black line in Figure 2 represents the flow in 2015, and starting in about mid-May it dips significantly below the depicted 10 percent exceedance flow.



Given the certainty of extremely low stream flows early in 2015, in March of 2015 WWT elected to collaborate on a reverse auction with the Dungeness Water Users Association, with the goal of leasing as much water as possible while paying fair market rates. WWT chose to utilize a reverse auction

Drought & Streamflow

approach with an unrevealed reserve price. Since the $100/acre revealed reserve price in 2009 generated participation from many smaller-scale irrigators, but not necessarily the larger irrigators, WWT anticipated that without a revealed reserve price, individual irrigators would bid more competitively and keep prices down. The general knowledge that the basin was experiencing perhaps the worst drought on record undoubtedly served to generate interest in the auction. WWT received 29 bids from 16 irrigators (some irrigators submitted bids on multiple fields). Only two bids were rejected due to high cost above WWT's reserve price, and one bid was deemed ineligible and was rescinded. Overall, WWT signed contracts in 2015 with 13 individuals on a total of 840 acres. This equates to an estimated 350 acre-feet of water (total volume) and 5.6 cfs of flow.

Source Substitution

In 2015, WWT also negotiated a source substitution project in the Dungeness Basin, which paid an irrigator to irrigate with deep groundwater rather than surface water. Clark Farms is a 90-acre grass fed beef operation located about a half a mile from the Straits of Juan de Fuca near the mouth of the Dungeness River. Clark Farms has access to irrigation water diverted by ditch from the Dungeness River as well as a groundwater right from a 617 foot deep well in the third aquifer. The hydrogeology of Dungeness Basin is well understood to support three aquifers, commonly referred to as shallow, middle, and deep aquifers. Ecology developed a groundwater model for the basin that estimated the total surface water capture from pumping from the third aquifer at this location amounted to 22% of surface water. This means that if Clark Farm's pump 37 acre-feet of water from the deep well, the total impact to surface streams in the Dungeness Valley is only about 8 acre-feet, spread across a larger area over a longer period of time. Given the high degree of scientific understanding of the interaction between groundwater and surface water in the watershed, WWT deemed that there is a significant hydrologic benefit in swapping from surface water to groundwater during the low flow period in the Dungeness River. The contract with Clark Farms is for five years, and hopefully the concept of well-timed and thoughtful source substitution can be applied elsewhere in the watershed to keep agriculture in production while providing flow in the river when fish need it the most. [Editor's Note: In other western states, the term "exchange of water" is often used rather than "source substitution]. The next section discusses some of the lessons learned specific to drought response programs this year and in previous drought years.

Surface Water Impact

LESSONS LEARNED

Time Limits

One of the key challenges to implementing stream flow restoration projects in a drought year is the limited time within which projects must be advertised, negotiated, and executed. Stream flow restoration practitioners watch snowpack carefully through the winter months. Practitioners often do not know if any individual basin will be experiencing low flow concerns as a result of low precipitation or snowpack until March or April. Under normal conditions it can take a year or more to coordinate funding, and negotiate and shuttle water right changes through state or court processes. A drought year requires a rapid response by project managers and access to transactions tools which can be quickly implemented. Therefore, knowing the social and hydrologic conditions in any one basin, and whether those conditions make it well suited for a fast-paced drought response program, is key to a successful program. As previously mentioned, only some of the stream flow restoration practitioner's tools are feasible in a drought year. A critical step in planning is to evaluate which flow restoration tool is likely to be most effective under an individual basin's legal status of water rights, biological flow restoration priorities, hydrogeology, and ability to coordinate partnerships with willing landowners.

Basin Considerations

In the 2015 Yakima Basin reverse auction, two bids were rescinded due to complexities in the legal status of the water rights. In order to protect the water instream, water rights must be protected via a special order ("Order pedente lite") from the Yakima Superior Court that temporarily changes the water right's *purpose* of use to instream flow while keeping the underlying water rights in sync with the pending adjudication in the basin. Any administrative issues with the water rights, such as a name change after property is sold or inherited, introduce processing delays that effectively preclude those water rights from participating in drought leasing. Transactions that require state and/or court approval can simply run out of time to benefit flows in a drought year. In the Dungeness Basin, the 2009 and 2015 reverse auction contracts did not require that the irrigation district or company transfer water rights to the State Trust Water Rights Program since they were temporary water leases, and this significantly expedited the13 contracts. WWT, Ecology, and the irrigators signed a monitoring agreement that commits the districts and companies to account for the water that is not used on farm as a result of the leasing program. The drawback of this approach, while saving processing time, is that the leased water is not transferred into the State Trust Water Rights program, which would provide a greater level of protection in stream.

Purpose of Use

Temporary Leases

Drought & Streamflow

Participation Factors

There were vastly different participation rates between the Dungeness and the Yakima auctions in 2015. A number of factors can affect participation: timing; reserve price (especially if revealed); comfort level with the facilitating entity; perceived severity of the drought; and the effectiveness of outreach methods. With these factors in mind, the underlying strategy of leasing programs in dry years is critical. WWT found that when the reserve price in the Dungeness Basin was not revealed a higher response rate resulted. This higher response rate also could have been affected by the irrigator's understanding that 2015 was likely to be a record dry year and their own access to water might also be jeopardized in the late season. In WWT's 2009 program it was also found that revealing a reserve price lower than was paid in previous years of leasing by Ecology resulted in some of the larger farms not participating. However in 2015, without a revealed reserve price, farms of all sizes participated in the Dungeness.

Trust

WWT has a nearly two decade record of working in these two basins, building relationships and reputation, which is suggestive of a willingness of water users to participate in both basins. Of the six accepted bids in the Yakima all had experience working with WWT on other water right contracts. In the Dungeness Basin, most of the bidders had either participated in Ecology or WWT's annual leasing programs in the past. Another likely factor of success in the Dungeness was WWT's collaboration with the Dungeness Water Users Association. The auction invitation letters that were mailed out were signed by WWT and the president of the Water Users, who is well known in the Valley. The letters in the 2015 Yakima Auction were sent by Ecology. Participation in a water leasing program, where there is so much uncertainty, requires a great deal of trust in the participating partners. As the state agency in Washington that manages water resources, water right holders generally have a variety of opinions and beliefs about Ecology. Given this context, participation in leasing programs may be increased if a more neutral third party nonprofit without regulatory authority facilitates a leasing program.

CONCLUSION

Established Programs

While the 2015 water year will be a year for the record books, climate change forecasts tell us that this year's precipitation patterns are likely to become more frequent. One of the key lessons learned from this drought year is that investment in stream flow restoration in non-drought years is essential to the implementation of drought response programs. Without established relationships between buyers and sellers, active water markets, and familiarity with water right transactions, water right holders are naturally less willing to participate in drought years. Even with an organizational history of engagement in a basin, drought response efforts need to be carefully tailored to best secure water supply that will benefit aquatic stream systems while being executed as quickly as possible. Drought response programs are still only scratching the surface of the problem. We need to continue to expand the use of existing stream flow restoration tools as well as try new ideas such as incentives for not watering lawns during dry years, better use of reclaimed water, targeted aquifer recharge to enhance stream flow, and perhaps even some off stream storage that can be used for irrigation in exchange for leaving water in rivers during key periods.

Many streams across Washington and the western US experience low flow challenges every year and these challenges are forecast to become even more severe with climate change and population growth. Investing in stream flow restoration in every year can help us support hydrographs that are capable of supporting salmon and their ecosystems every year in a changing climate.

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RISK-BASED UST SITE CLOSURES

TECHNICALLY SOUND / GOOD ECONOMICS FOR UNDERGROUND STORAGE TANK CLEANUPS

by Jeff Gaarder, GHD (Lynnwood, WA)

Risk-Based UST Site Closures

Cost-Effective Approach

Stringency

Low-Risk Sites

Cleanup Drivers

Risk-Based Regulations

Resource Allocation

Residual Contamination

Natural Attenuation

INTRODUCTION

It is well known and documented that petroleum releases from **u**nderground **s**torage **t**ank (UST) sites threaten the quality of our soils and groundwater. It is also well known and documented that risk-based cleanup protocols provide a cost-effective approach to remediating impacted sites under appropriate site conditions. Unfortunately, in many land use settings, some state cleanup regulations still require that these leaking UST impacts be remediated to unreasonable levels, leading to unnecessarily high costs and prolonged or postponed closures.

One example of such cleanup regulations are those required by the Washington State Department of Ecology's (Ecology) Model Toxics Control Act (MTCA). Ecology's UST/LUST [**l**eaking **u**nderground **s**torage **t**ank] September 2014 Program status as reported by the United States Environmental Protection Agency (EPA) indicates that there are 6,789 confirmed release sites in Washington State. Over 2,000 of the leaking UST sites have historical contamination that remains unremediated due to the difficulties with achieving Washington's stringent MTCA Method A cleanup levels. Site remediation is costly; typical costs to cleanup a site can exceed a million dollars and lifecycles can reach from 20 to 30 years. It is likely that many of these sites are active service stations located in busy commercial areas and have already been through robust cleanup activities. These sites often pose little to no risk to potential ecological receptors. Yet, despite past cleanup efforts, the residual petroleum impacts beneath the site remain above cleanup levels and therefore do not meet closure requirements.

Consequently, more and more responsible parties are making business decisions to cease cleanup activities unless there are critical drivers for implementing mitigation measures. These drivers include regulatory orders for sites posing imminent threat to health, safety, and the environment, or drivers such as property divestment and litigation. As a result, a significant number of these sites will continue to languish without any further assessment or remediation unless there are more favorable regulatory policies established or other business reasons to drive cleanups. Further, EPA's funding to Ecology's UST/LUST program will remain in jeopardy as fewer and fewer sites will reach regulatory closure (EPA, Washington LUST Strategic Plan, March 13, 2014).

Unfortunately this situation has been the norm for many states when trying to remediate sites to unreasonable cleanup levels. As a result, several states — including Idaho, Kansas, Missouri, Montana, and Oregon — have adopted risk-based regulations for site cleanups to help ease the financial burden on responsible parties and expeditiously push UST sites to closure while still protecting health, safety, and the environment. A good example of a recent policy change occurred in the State of California where, in August 2012, the state legislature passed legislation enabling the "Low-threat Underground Storage Tank Closure Policy."

This article presents an overview of this policy along with a comparison of regulatory closures by our firm before and after California's policy implementation.

CALIFORNIA'S LOW-THREAT CLOSURE POLICY

California's state-wide Low-threat Underground Storage Tank Closure Policy (LTCP) was developed by the State Water Resources Control Board's UST Program staff. It was crafted to allocate limited financial resources to high-risk sites by expediting closure to sites considered to have a low potential to impact human health and water resources.

Decades of petroleum cleanup experience has demonstrated the ability of remedial technologies to mitigate a substantial fraction of a petroleum contaminant mass with the investment of a reasonable level of effort. However despite these efforts, residual contaminant mass usually remains and this mass is difficult to completely remove regardless of the level of additional effort and resources invested, which can increase cleanup cost exponentially.

It has been well-documented in the literature (Lawrence Livermore National Laboratory, 1995; SB 1764 Committee Report, 1996; UST Cleanup Program Task Force, 2010; etc.) and through experience at individual UST release sites that petroleum fuels naturally attenuate in the environment through adsorption, dispersion, dilution, volatilization, and biological degradation. This natural attenuation slows and limits the

Risk-Based UST Site Closures

migration of dissolved petroleum plumes in groundwater. The biodegradation of petroleum, in particular, distinguishes petroleum products from other hazardous substances commonly found at commercial and industrial sites. These studies have demonstrated that many petroleum release cases pose a low threat to human health and the environment.

The purpose of LTCP is to establish consistent statewide case closure criteria for low-threat petroleum UST sites. The policy is consistent with existing statutes, regulations, State Water Board precedential decisions, policies and resolutions, and is intended to provide clear direction to responsible parties, their service providers, and regulatory agencies. The policy seeks to increase UST cleanup process efficiency. A benefit of improved efficiency is the preservation of limited resources for mitigation of releases posing a greater threat to human and environmental health.

Low-Threat Sites

Criteria for Low-Threat Case Closure

In the absence of unique attributes of a case or site-specific conditions that demonstrably increase the risk associated with residual petroleum constituents, cases that meet the general and media-specific criteria described in this policy pose a low threat to human health, safety, or the environment and are appropriate for closure pursuant to California's Health and Safety Code section 25296.10. Cases that meet the criteria in this policy do not require further corrective action and shall be issued a uniform closure letter consistent with Health and Safety Code section 25296.10. Annually, or at the request of the responsible party or party conducting the corrective action, the regulatory agency shall conduct a review to determine whether the site meets the criteria contained in this policy.

Closure Letter

Agency Discretion

It is important to emphasize that the criteria described in this policy do not attempt to describe the conditions at all low-threat petroleum UST sites in the State. The regulatory agency shall issue a closure letter for a case that does not meet these criteria if the regulatory agency determines the site to be low-threat based upon a site-specific analysis.

Conceptual Site Model

This policy recognizes that some petroleum-release sites may possess unique attributes and that some site-specific conditions may make case closure under this policy inappropriate, despite the satisfaction of the stated criteria in this policy. It is impossible to completely capture those sets of attributes that may render a site ineligible for closure based on this low-threat policy. This policy relies on the regulatory agency's use of the conceptual site model to identify the special attributes that would require specific attention prior to the application of low-threat criteria. In these cases, it is the regulatory agency's responsibility to identify the conditions that make closure under the policy inappropriate.

Low-Threat Criteria

General Criteria

General criteria that must be satisfied by all candidate sites are listed as follows:

a. The unauthorized release is located within the service area of a public water system;
b. The unauthorized release consists only of petroleum;
c. The unauthorized ("primary") release from the UST system has been stopped;
d. Free product has been removed to the maximum extent practicable;
e. A conceptual site model that assesses the nature, extent, and mobility of the release has been developed;
f. Secondary source has been removed to the extent practicable;
g. Soil or groundwater has been tested for **m**ethyl **t**ert-**b**utyl **e**ther (MTBE) and results reported in accordance with Health and Safety Code section 25296.15; and
h. Nuisance as defined by Water Code section 13050 does not exist at the site.

Media-Specific Criteria

Media Specificity

Releases from USTs can impact human health and the environment through contact with any or all of the following contaminated media: groundwater, surface water, soil, and soil vapor. Although this contact can occur through ingestion, dermal contact, or inhalation of the various media, the most common drivers of health risk are ingestion of groundwater from drinking water wells, inhalation of vapors accumulated in buildings, contact with near surface contaminated soil, and inhalation of vapors in the outdoor environment. To simplify implementation, these media and pathways have been evaluated and the most common exposure scenarios have been combined into three media-specific criteria.

LTCP Media-Specific Criteria are:

1. Groundwater
2. Vapor Intrusion to Indoor Air
3. Direct Contact and Outdoor Air Exposure

Candidate sites must satisfy all three of these media-specific criteria as described below.

Groundwater

Groundwater-Specific Criteria

(1) a. The contaminant plume that exceeds water quality objectives is less than 100 feet in length.
b. There is no free product.

Risk-Based UST Site Closures

Groundwater

c. The nearest existing water supply well or surface water body is greater than 250 feet from the defined plume boundary.

(2) a. The contaminant plume that exceeds water quality objectives is less than 250 feet in length.
b. There is no free product.
c. The nearest existing water supply well or surface water body is greater than 1,000 feet from the defined plume boundary.
d. The dissolved concentration of benzene is less than 3,000 micrograms per liter (µg/l), and the dissolved concentration of MTBE is less than 1,000 µg/l.

(3) a. The contaminant plume that exceeds water quality objectives is less than 250 feet in length.
b. Free product has been removed to the maximum extent practicable, may still be present below the site where the release originated, but does not extend off-site.
c. The plume has been stable or decreasing for a minimum of five years.
d. The nearest existing water supply well or surface water body is greater than 1,000 feet from the defined plume boundary.
e. The property owner is willing to accept a land use restriction if the regulatory agency requires a land use restriction as a condition of closure.

(4) a. The contaminant plume that exceeds water quality objectives is less than 1,000 feet in length.
b. There is no free product.
c. The nearest existing water supply well or surface water body is greater than 1,000 feet from the defined plume boundary.
d. The dissolved concentration of benzene is less than 1,000 µg/l, and the dissolved concentration of MTBE is less than 1,000 µg/l.

Agency Determination

(5) a. The regulatory agency determines, based on an analysis of site-specific conditions that under current and reasonably anticipated near-term future scenarios, the contaminant plume poses a low threat to human health and safety and to the environment and water quality objectives will be achieved within a reasonable time frame.

Sites with Releases That Have Not Affected Groundwater:

Sites with soil that does not contain sufficient mobile constituents [leachate, vapors, or **li**ght **n**on-**a**queous-**p**hase **l**iquids (LNAPL)] to cause groundwater to exceed the groundwater criteria in this policy shall be considered low-threat sites for the groundwater medium. Provided the general criteria and criteria for other media are also met, those sites are eligible for case closure.

For older releases, the absence of current groundwater impact is often a good indication that residual concentrations present in the soil are not a source for groundwater pollution.

Vapor Intrusion

Petroleum Vapor Intrusion to Indoor Air

Exposure to petroleum vapors migrating from soil or groundwater to indoor air may pose unacceptable human health risks. This policy describes conditions, including bioattenuation zones, which if met will assure that exposure to petroleum vapors in indoor air will not pose unacceptable health risks. In many petroleum release cases, potential human exposures to vapors are mitigated by bioattenuation processes as vapors migrate toward the ground surface. For the purposes of this section, the term "bioattenuation zone" means an area of soil with conditions that support biodegradation of petroleum hydrocarbon vapors.

Adjacency Issues

The low-threat vapor-intrusion criteria described below apply to sites where the release originated and impacted or potentially impacted adjacent parcels when: (1) existing buildings are occupied or may be reasonably expected to be occupied in the future; or (2) buildings for human occupancy are reasonably expected to be constructed in the future.

Petroleum release sites shall satisfy the media-specific criteria for petroleum vapor intrusion to indoor air and be considered low-threat for the vapor-intrusion-to-indoor-air pathway if:

a. Site-specific conditions at the release site satisfy all of the characteristics and criteria of scenarios 1 through 3 as applicable, or all of the characteristics and criteria of scenario 4 as applicable; or
b. A site-specific risk assessment for the vapor intrusion pathway is conducted and demonstrates that human health is protected to the satisfaction of the regulatory agency; or
c. As a result of controlling exposure through the use of mitigation measures or through the use of institutional or engineering controls, the regulatory agency determines that petroleum vapors migrating from soil or groundwater will have no significant risk of adversely affecting human health.

Active Facilities Exception

Exception: Exposures to petroleum vapors associated with historical fuel system releases are comparatively insignificant relative to exposures from small surface spills and fugitive vapor releases that typically occur at active fueling facilities. Therefore, satisfaction of the media-specific criteria for petroleum vapor intrusion to indoor air is not required at active commercial petroleum fueling facilities, except in cases where release characteristics can be reasonably believed to pose an unacceptable health risk.

Risk-Based UST Site Closures

Outdoor Air Exposure

Direct Contact and Outdoor Air Exposure

This policy describes conditions where direct contact with contaminated soil or inhalation of contaminants volatized to outdoor air poses a low threat to human health. Release sites where human exposure may occur satisfy the media-specific criteria for direct contact and outdoor air exposure and shall be considered low-threat if they meet any of the following:

a. Maximum concentrations of petroleum constituents in soil are less than or equal to those listed in Table 1 for the specified depth **b**elow **g**round **s**urface (bgs). The concentration limits for 0 to 5 feet bgs protect from ingestion of soil, dermal contact with soil, and inhalation of volatile soil emissions and inhalation of particulate emissions. The 5 to 10 feet bgs concentration limits protect from inhalation of volatile soil emissions. Both the 0 to 5 feet bgs concentration limits and the 5 to 10 feet bgs concentration limits for the appropriate site classification (Residential or Commercial/Industrial) shall be satisfied. In addition, if exposure to construction workers or utility trench workers are reasonably anticipated, the concentration limits for Utility Worker shall also be satisfied; or

b. Maximum concentrations of petroleum constituents in soil are less than levels that a site-specific risk assessment demonstrates will have no significant risk of adversely affecting human health; or

c. As a result of controlling exposure through the use of mitigation measures or through the use of institutional or engineering controls, the regulatory agency determines that the concentrations of petroleum constituents in soil will have no significant risk of adversely affecting human health.

No Significant Risk Concentrations

Table 1
Concentrations of Petroleum Constituents in Soil That Will Have No Significant Risk of Adversely Affecting Human Health

Chemical	Residential		Commercial/ Industrial		Utility Worker
	0 to 5 feet bgs	Volatilization to outdoor air (5 to 10 feet bgs)	0 to 5 feet bgs	Volatilization to outdoor air (5 to 10 feet bgs)	0 to 10 feet bgs
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Benzene	1.9	2.8	8.2	12	14
Ethylbenzene	21	32	89	134	314
Naphthalene	9.7	9.7	45	45	219
PAH[1]	0.063	NA	0.68	NA	4.5

Notes:
1. Based on the seven carcinogenic poly-aromatic hydrocarbons (PAHs) as benzo(a)pyrene toxicity equivalent [BaPe]. Sampling and analysis for PAH is only necessary where soil as affected by either waste oil or Bunker C fuel.
2. The area of impacted soil where a particular exposure occurs is 25 by 25 meters (approximately 82 by 82 feet) or less.
3. NA = not applicable
4. mg/kg = milligrams per kilogram

Closure Process

Low-Threat Case Closure

Cases that meet the general and media-specific criteria established in this policy pose a low threat to human health, safety, and the environment and satisfy the case-closure requirements of Health and Safety Code section 25296.10, and case closure is consistent with State Water Board Resolution 92-49 that requires that cleanup goals and objectives be met within a reasonable time frame. If the case has been determined by the regulatory agency to meet the criteria in this policy, the regulatory agency shall notify responsible parties that they are eligible for case closure and that the following items, if applicable, shall be completed prior to the issuance of a uniform closure letter specified in Health and Safety Code section 25296.10. After completion of these items, and unless the regulatory agency revises its determination based on comments received on the proposed case closure, the regulatory agency shall issue a uniform closure letter within 30 days from the end of the comment period.

Notification

a. Notification Requirements: Municipal and county water districts, water replenishment districts, special act districts with groundwater management authority, agencies with authority to issue building permits for land affected by the petroleum release, owners and occupants of the property impacted by the petroleum release, and the owners and occupants of all parcels adjacent to the impacted property shall be notified of the proposed case closure and provided a 60 day period to comment. The regulatory agency shall consider any comments received when determining if the case should be closed or if site-specific conditions warrant otherwise.

Risk-Based UST Site Closures

b. Monitoring Well Destruction: All wells and borings installed for the purpose of investigating, remediating, or monitoring the unauthorized release shall be properly destroyed prior to case closure unless a property owner certifies that they will keep and maintain the wells or borings in accordance with applicable local or state requirements.

c. Waste Removal: All waste piles, drums, debris and other investigation or remediation derived materials shall be removed from the site and properly managed in accordance with regulatory agency requirements.

SUMMARY

Policy Benefits

California's recent adoption of the LTCP makes good economic sense and uses sound technical criteria to establish low-risk conditions allowing sites to close with some residual petroleum contamination. In the absence of this risk-based policy, these UST sites would continue to languish and a significant increase in spending and resources would likely be necessary in order to achieve site closure.

Increased Closure Rates

Our firm has performed environmental consulting services for many petroleum clients for the past 25 years across North America. In California, our site closure record prior to the LTCP is considered to be very good by our clients. An analysis of UST site closures before and after LTCP implementation indicates that during the three years prior to LTCP, site closures for one of our clients were averaging 40 sites per year. The post LTCP closure rate has been approximately 70 sites per year, which is a 75 percent increase. This increase is to be expected as that is the purpose of the LTCP — i.e., establish that sites present low-risk or threat and then close them so our limited resources can focus efforts on mitigating releases posing a much greater threat to human and environmental health. This increase in closure rates allows for a reduction in project lifecycles, which may be as much as ten years and a decrease in the costs to closure which may range from tens to hundreds of thousands of dollars depending on the site circumstances.

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Author Jeff Gaarder will be speaking on
The **Washington State Department of Ecology's** efforts to establish standardized
"Model Remedies" for Cleanup Sites, including the first draft
Model Remedy for Petroleum Contaminated Sites at the:
Re-Using Contaminated Land Conference — October 8th in Seattle

Jeff Gaarder, GHD, is Principal in Charge for GHD's Pacific Northwest Offices (Lynnwood and Tacoma, WA). Mr. Gaarder oversees approximately 100 oil and gas sites in western Washington, Oregon, and Alaska. These projects sites include former and active service stations, bulk fuel terminals, and maintenance facilities. The sites are at various stages of environmental cleanup including UST removal, preliminary and subsequent site investigations, and remediation implementation. Consistent regulatory interface and advocacy on risk-based solutions has led to closure of approximately 60 sites in the last seven years. He supervises approximately 20 professionals consisting of geologists, engineers, scientists, and technicians involved with: sediment and upland soils remediation and restoration; wetland permitting and restoration; stormwater and surface water planning; environmental site assessments; feasibility studies, risk assessments; remedial planning; remedial system installation; remedial system operation and maintenance; and regulatory site closure.

Bioretention Performance

"LID" Requirements

Bioretention Site Integration

Contaminant Export Findings

Issues Raised

Further Study

BIORETENTION PERFORMANCE

PACIFIC NORTHWEST STUDY IDENTIFIES PROBLEMS & SOLUTIONS

by Dylan Ahearn, Curtis Hinman, and John Lenth (Herrera Environmental Consultants, Seattle, WA) & Andy Rheaume (City of Redmond, WA)

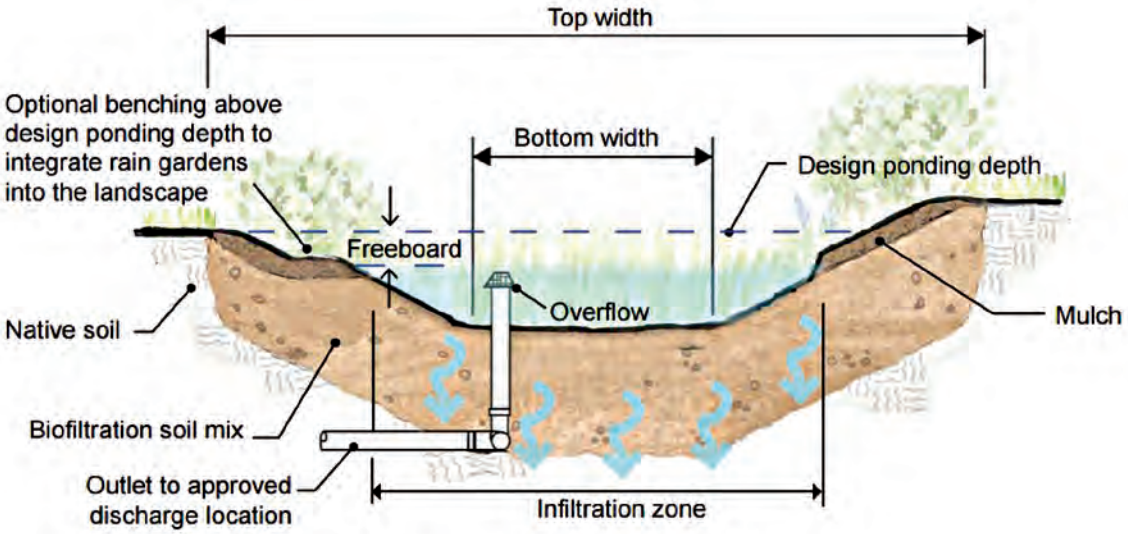
INTRODUCTION

The current Washington State, Phase I Municipal Stormwater Permit (effective August 1, 2013) requires the use of **l**ow **i**mpact **d**evelopment (LID) practices as the first option for managing stormwater runoff where feasible. Bioretention is the most widely applicable and flexible Best Management Practice (BMP) in the suite of LID practices. Bioretention facilities are shallow landscaped depressions with a designed soil mix and plants adapted to the local climate and soil moisture conditions. Sized to receive stormwater from a small contributing area, these systems are designed to more closely mimic natural forested conditions where healthy soil structure and vegetation promote the infiltration, storage, filtration, and slow release of stormwater flows. When used in a typical LID application, bioretention areas are designed as small-scale, dispersed systems that are integrated into the site as a landscape amenity.

To ensure the consistent performance of BMPs for stormwater treatment in Western Washington, the Washington State Department of Ecology's (Ecology's) 2014 Stormwater Management Manual for Western Washington (SWMMWW) identifies requirements for selecting, sizing, and constructing LID practices including bioretention. The SWMMWW specifically requires that the default **b**ioretention **s**oil **m**edia (BSM) used to construct bioretention facilities contain a mixture of 60 percent sand and 40 percent compost (60/40 Mix). Bioretention systems constructed with this BSM have been shown to provide good water quality treatment for many contaminants (e.g., sediment, zinc, hydrocarbons, and likely bacteria), and bioretention is currently classified in the SWMMWW as a basic (solids removal) and enhanced (copper and zinc removal) treatment BMP.

However, findings from a 2013 study of roadside bioretention performance in the City of Redmond (Herrera 2014) and from the Washington State University LID Research Facility (WSU 2014) found that bioretention systems were actually exporting copper as opposed to reducing it. In addition to copper, a number of recent regional studies have also documented nitrogen and phosphorus export from bioretention. While raising concerns, the duration and magnitude of metals and nutrient export were not fully documented in each individual study. Furthermore, it was unclear which media components were contributing to pollutant export and if alternate media compositions would, on average, perform better than the default BSM specification of 60/40 Mix. These findings called into question bioretention's enhanced classification, the use of bioretention for stormwater treatment in general, and precipitated further studies of bioretention performance in the region.

To help address these data gaps, a meta-analysis was conducted to identify common trends among regional studies. This article summarizes and discusses the data from five studies that have been



Typical Bioretention Cross-Section

Bioretention Performance

implemented in the Puget Sound region to evaluate the hydraulic and water quality treatment performance of various BSMs over the past five years.

Puget Sound region studies analyzed for this article include:

- Tacoma Salishan Study (City of Tacoma 2015)
- WSU Mesocosm Study (WSU 2014)
- Redmond 185th Study (Herrera 2014)
- Redmond Six Swales (Herrera 2015b)
- Kitsap Column Study (Herrera 2015a)

This article identifies the specific BSMs that were evaluated in connection with these studies. The results from these studies are then summarized relative to three areas of consideration germane to BSM treatment performance.

BSM Performance Areas

The areas of BSM treatment performance consideration are:

Infiltration: SWMMWW assumes a default infiltration rate of water through the BSM of 12 inches per hour. Higher infiltration rates will increase the treatment capacity of the BSM; however, this increase may come at the expense of water quality treatment performance.

Water Quality Treatment Performance: a primary goal of the ongoing BSM research is to optimize the water quality treatment performance of these systems for common pollutants in stormwater runoff.

Physical and Chemical Properties: the SWMMWW identifies specific physical and chemical criteria for the default BSM to ensure it provides consistent water quality treatment performance and act as a growth media for plants. New BSMs must exhibit the requisite physical and chemical properties to provide these same functions.

ANALYSIS PROTOCOLS & FINDINGS

The subsequent discussion provides context for interpreting the results from the five Pacific Northwest studies relative to results from past studies and studies from other regions.

Materials and Methods

In the five studies above, 19 separate BSMs were tested in either the lab or field and over 70 parameters were analyzed. To reduce the data and explore trends among BSMs with different components the 19 BSMs were grouped into the following four categories:

BSM Testing Groups

- 60/40 Mix (seven BSMs tested)
- 60/40 + Additives (five BSMs tested)
- Loamy Sand (two BSMs tested)
- Sand/Coir + Additives (five BSMs tested)

BSM Constituents

Compost was derived from yard and food waste feedstocks following guidelines from Washington Administration Code 173-350-220. Coir used in the studies was composed of coconut shell and pith that had been soaked, pulverized and conditioned for horticultural use. The sands were secured from aggregate suppliers and generally followed a C-33 gradation with low fines (less than five percent passing the 200 sieve). A volcanic-origin sand (Mt Saint Helens) was used for the Kitsap column study. Additives for the BSMs included one or more of the following: activated alumina; biochar; diatomaceous earth; granular activated carbon; high carbon wood ash (log yard waste burned in co-generation facilities); shredded bark; and water treatment residuals (aluminum and iron hydroxides used to settle fine particulates in drinking water intakes).

Typical Bioretention Swales (from City of Seattle and Kitsap County)

Bioretention Performance

"Flushing Period"

Stormwater Infiltration

Infiltration Rates

In order to characterize the temporal nature of bioretention performance, the effluent concentrations from each BSM category were plotted against the amount of water that had been introduced to the respective systems since they went online. In addition, the mean influent and effluent concentrations, and median percent reductions were calculated for each BSM category. Finally, where pollutant export was documented from a specific BSM, the duration of this export (referred to as the "flushing period") was quantified. The flushing period determinations were based on the BSM being properly sized to treat stormwater runoff in Seattle, Washington, pursuant to the SWMMWW. The volume of water that was introduced to the system reflected the amount it would receive over a typical "water year" (i.e., precipitation measured from October 1 through September 30). Using this approach, it can be inferred that a system would likely still be flushing pollutants after one year of operation in this region if it was observed to still be exporting pollutants after receiving this equivalent volume of water.

The hydraulic performance of a system is influenced by the rate of stormwater infiltration through the BSM. Higher infiltration rates will increase the treatment capacity of the system; however, this increase may come at the expense of water quality treatment performance. To assess hydraulic performance, infiltration testing results were summarized across BSM categories and compared with effluent concentrations. Finally, the physical and chemical properties of each media component were summarized across the studies and trends identified.

Results: Infiltration

The infiltration rates for the 60/40 Mix were, on average, a minimum of 12 inches per hour (in/hr), and as high as 200 in/hr; higher than the Ecology specification of 2-12 in/hr for an initial or measured rate. When additives were used to augment a 60/40 Mix there was a decrease in infiltration rates. This was likely due to the fact that many of the additives used (e.g., biochar, water treatment residuals) are either fine grained or have a high water holding capacity. The Loamy Sands exhibited the lowest infiltration rates among the BSMs tested, while the Sand/Coir + Additives exhibited the highest infiltration rates in every test except permeability testing. Relationships between infiltration rates and effluent concentrations were only evident for **t**otal **s**uspended **s**olids (TSS) — where a noted increase in TSS effluent concentrations was associated with increased infiltration rates.

Bioretention Testing Facility for the Redmond Six Swales study (Herrera 2015b).

Bioretention Performance

Testing Parameters

TSS Flushing

Phosphorus Removal

Ortho-Phosphate

Nitrate/Nitrite

Results: Water Quality Treatment

As indicated above, 70 parameters were analyzed among the five studies to evaluate the water quality treatment performance of the various BSMs. In order to simplify the discussion, eight parameters of interest were selected out of the 70 for detailed analysis: TSS; total phosphorus; ortho-phosphate; nitrate + nitrite; dissolved copper; dissolved zinc; fecal coliform bacteria; and total petroleum hydrocarbons (TPH-Oil).

TSS flushing from the BSMs was essentially complete (i.e., effluent concentrations were no longer elevated relative to influent concentrations) by one water year (100%WY) and effluent values for all BSM categories converged on a value of less than 10 **m**illigrams **p**er **l**iter (mg/L). Sand/Coir + Additives (using relatively uniform sands with high infiltration rates) flush significantly more TSS than the other BSMs. The 60/40 Mixes perform the best, and the 60/40 + Additives and Loamy Sands fall somewhere in between. The use of a sandy drainage layer as opposed to a type-26 drainage layer seemed to improve TSS performance.

The best performers for total phosphorus removal were the loamy sands, the Sand/Coir + Additives, and the 60/40 + Additives from the Kitsap Column Study. This last BSM contained a polishing layer which resulted in a high level of solids retention. The total phosphorus performance of this BSM can be attributed primarily to the reduction in solids export, but also sorption of ortho-phosphorus to activated alumina in the layer, whereas the total phosphorus performance of the Sand/Coir + Additives can be attributed to ortho-phosphate reduction. The 60/40 Mix performed the worst with an average effluent concentration of 0.6 mg/L.

Both the 60/40 Mix and the 60/40 + Additives exported significantly more ortho-phosphate than the Sandy Loams and the Sand/Coir + Additives. The 60/40 + Additives and the Sand/Coir + Additives exhibited a slight flush which was complete by 25%WY. The 60/40 Mix exhibited a different flushing pattern with a peak at 50%WY and then a gradual flush (average effluent = 0.45 mg/L) which may last more than 300%WY. Nitrate + nitrite exhibited a flushing pattern similar to ortho-phosphate with the 60/40 Mix performing the worst and the Sand/Coir + Additives performing significantly better than the other BSMs. The 60/40 Mix exhibited a peak effluent concentration at 50%WY and then decreased by 100%WY

Key
1: 200 gallon (757 liter) cone bottom HDPE mixing tank.
2: mixer (10 hp electric motor with 8-inch propeller).
3: 15 gallon (189 liter) cone bottom HDPE distribution tank.
4: peristaltic pumps (Chem-Tech XP series, model XP080LALX).
5: PVC columns.

Column Array used for Kitsap Column Study Flushing and Dosing Experiments During the Kitsap Column Study (Herrera 2015a)

Bioretention Performance

Copper Export

to an equilibrated effluent concentration of ~0.4 mg/L. The 60/40 + Additives and the Loamy Sands performed similarly, flushing to ~0.4 mg/L by 50%WY. The Sand/Coir + Additives flushed very little Nitrate + nitrite and equilibrated to ~0.1 mg/L by 25%WY.

Dissolved copper dynamics were similar to those of total phosphorus. The 60/40 Mix exported the highest initial concentrations and then the effluent equilibrated after 200%WY to approximately five micrograms per liter (ug/L). However, due to considerable variability in the data it is difficult to say if results indicate equilibration. The 60/40 + Additives and Sandy Loam BSMs performed slightly better but were still outperformed by the Sand/Coir + Additives. The Sand/Coir + Additives were significantly better performers than the other BSM categories, beginning with a low level flush and then equilibrating to an effluent concentration of approximately one ug/L.

Zinc

Each BSM tended to reduce influent concentrations of dissolved zinc. In addition, there was a slight flushing pattern observed from the 60/40 Mix, the 60/40 + Additives, and the Loamy Sands, which was complete by 50%WY. Overall, after flushing was complete effluent concentrations among all the BSM categories averaged five ug/L (near the detection limit).

Fecal Coliform

A fecal coliform flush bacteria by 100%WY was evident in each BSM category. The flush from the Sand/Coir + Additives was more rapid; however, due to the fact that only one study analyzed fecal coliform for the Sand/Coir + Additives, it is difficult to say if this trend is site specific or more pervasive.

TPH-Oil

There was no strong flushing trend for TPH-Oil in any of the BSM categories. The Loamy Sands and Sand/Coir + Additives exhibited the lowest effluent concentrations; however, similar to fecal coliform bacteria, only one study analyzed TPH-Oil for the Sand/Coir + Additives — it is therefore difficult to draw conclusions regarding treatment performance for this parameter among the BSM categories.

Results: Physical and Chemical Properties

Filters & Growth Media

A number of BSM physical and chemical criteria are specified in the SWMMWW to ensure that BSMs perform well as filters and growth media. These criteria (specifically, **o**rganic **m**atter (OM) content, saturated hydraulic conductivity ("Ksat"), and **c**ation **e**xchange **c**apacity (CEC)) were compared with the results from the five studies. OM content is an important measure of a BSM's ability to hold water and thus serve as acceptable growth media for plants. Ksat is a measure of the rate that water will infiltrate through the BSM under saturated conditions. As noted previously, higher infiltration rates will increase the treatment capacity of the system; however, this increase may come at the expense of water quality treatment performance. CEC is an important measure of a BSM's ability to remove certain types of pollutants through sorption.

Attained Results

On average, the OM criterion was not met by any of the BSM categories — even the 60/40 which contains more organic material than any of the other BSM categories. The Ksat criterion was, on average, only met by the Loamy Sands. Finally, the CEC criterion, which is included in the specification to help ensure that custom media blends can bind cations (specifically metals), is the lowest in the Sand/Coir + Additives mixes even though those media were far superior at removing metals when compared with the other BSM categories. Of particular significance is the fact that the Sand/Coir + Additives mixes were furthest from meeting any of the three aforementioned criteria, yet were consistently the best performers in terms of water quality treatment.

Leaching Protocol

Three of the five studies conducted **s**ynthetic **p**recipitation **l**eaching **p**rotocol (SPLP) analyses to identify media components that may be contributing to pollutant export. Compost exhibited the highest SPLP values of any of the media components. Of the aggregates tested, relatively high levels of leachable copper was found in C-33 sands, but sands with lower copper concentrations were identified in other studies. Compost leached an order of magnitude more nitrogen than coconut coir or shredded bark. Copper was five to eight times higher in the compost and ortho-phosphate was three to thirteen times higher in the compost when compared with the other organic media. The additives tended to leach very little copper and nutrients with a few exceptions. Biochar leached high nutrient concentrations, activated alumina leached nitrate at 0.44 mg/L, and the wood ash leached 0.52 mg/L of ortho-phosphate.

DISCUSSION

EARLIER CONCLUSIONS QUESTIONABLE

Research Impetus

The impetus for this synthesis of regional research on bioretention performance was research conducted at WSU and Redmond in 2011 and 2012, respectively. These studies indicated that, contrary to much of the most-widely cited literature (Ahiablame et al. 2012; Davis et al. 2009; Davis et al. 2003; Dietz 2007; Geosyntec 2013; Hunt et al. 2006; Seelsaen et al. 2006) bioretention systems were exporting nutrients and copper.

Bioretention Performance

Literature Discrepancies

Metals Removal Study

One conclusion of this report is that the findings from the WSU mesocosms (i.e., pilot-scale systems using media tanks holding bioretention soil mix during testing) and the Redmond 185th studies have been corroborated. The 60/40 Mix consistently exports phosphorus, nitrogen, and copper during a flushing phase, which lasts for at least one water year and perhaps longer than two water years.

Before we discuss the details of these findings and how we can improve the Ecology BSM specification, it is worth examining how this discrepancy between the published literature and results from regional studies came about.

One of the earliest and most cited studies on bioretention metals removal performance was conducted by Davis et al. (2003). The authors of this study used a combination of mesocosms and field studies to examine the performance of a loamy sand media and began testing after vegetation establishment. Influent copper concentrations for this study ranged from 66 to 140 ug/L. The authors found dissolved copper removals ranging from 82 to 93 percent. The study was subsequently cited in numerous influential literature reviews (Ahiablame et al. 2012; Davis et al. 2009; Dietz 2007) and has been used locally to highlight expected metals removal performance of bioretention systems in western Washington (Geosyntec 2013; Taylor Aquatic Science and Policy and Cardno TEC 2013). However, the loamy sand media evaluated is not representative of the 60/40 Mix used in this region because it does not contain compost. Influent dissolved copper concentrations used in the Davis et al. (2003) study were also substantially higher than those typically observed in this region, which generally range from 2.3 to 11 ug/L (Ecology 2011a). Furthermore, monitoring was delayed to allow vegetation establishment; therefore, an initial flushing of metals from newly installed systems may have been missed. Consequently, extrapolation of the Davis (2003) results to predict the performance of systems in western Washington may lead to spurious conclusions.

Problematic Findings

Another early full-scale bioretention field study was conducted by Hunt et al. (2006). The authors of this study found total phosphorus and nitrate export on a concentration basis, but since the system was unlined and infiltrated between 46 to 93 percent of influent volume, mass removal values of total phosphorus and nitrate were high and no export (on a mass basis) was evident. These findings, along with mass removals of copper were reported in the abstract. The mass removal values from this study were subsequently reported in Dietz (2007), Taylor Aquatic Science and Policy and Cardno (2013), and Ahiablame et al. (2012) with other studies reporting concentration percent removals, thus skewing the overall results in favor of removal.

Skewed Interpretations

In another example of how the literature is either misreported or not comparable to the studies summarized in this synthesis report, Seelsaen et al. (2006) found that compost was most effective at removing copper (90-93 percent removal) out of eight BSMs tested in a laboratory sorption study. However, initial solution concentrations of copper in the synthetic stormwater were 5 mg/L, or 500 times that of typical stormwater in western Washington. It is unclear if lower initial concentrations would have revealed a release of copper from the compost media.

Regional Conditionality

What is evident from this brief survey of the literature is that studies from other locations, using different BSMs, different influent concentrations, and different methods, provide little useful information for predicting how bioretention systems will perform in western Washington. Instead, the results from this report should be used as a reference for expected treatment performance of bioretention in this region.

CONCLUSIONS

Puget Sound Region Conclusions

The combined results from the five BSM performance studies that were implemented in the Puget Sound region were generally consistent in supporting the following conclusions:

- The most commonly exported pollutants were copper, nitrogen, and phosphorus. All BSMs performed well for TPH, fecal coliform, and zinc removal.
- Of the 19 BSMs evaluated in this synthesis report, the 60/40 Mix was, on average, the worst performing in terms of pollutant flushing and pollutant reduction.
- Conversely, on average, the best performing BSMs were those that contained Sand/Coir + Additives.
- Flushing results indicate that by one water year the majority of BSMs have completed their equilibration/flushing period. However, the BSMs with compost tend to export relatively high levels of total phosphorus, nitrate + nitrite, and dissolved copper for at least three water years.
- A high degree of dissolved pollutant removal is achievable at infiltration rates that exceed the current 2-12 in/hr requirement; however, solids removal suffers at the same high flow rates.
- The use of a sand aggregate underdrain material in conjunction with a slotted drain seems to reduce the export of solids and associated pollutants from the BSMs.

Bioretention Performance

Underdrains Guidance

Further Revisions Anticipated

A full report with a more detailed summary of the results from these studies will be prepared in early 2016 and be made available through the City of Redmond and Ecology. Based on these results, Ecology issued interim guidance in March 2014 that recommended bioretention systems with underdrains not be used where there would be a direct discharge to surface waters due to concerns over potential acute and chronic toxicity for aquatic life. This same guidance also recommended these systems not be used in areas where shallow groundwater is used for drinking water due to human health concerns.

To address these concerns, it is anticipated that the results from these studies in combination with results from future studies will help inform revisions to the default specification for BSM in the next update to the SWMMWW. Prior to the release of this update, it is also anticipated that Ecology will release interim guidance for BSM construction based on this research. The ultimate goal will be to identify a BSM with improved performance for capture and retention of nitrogen, phosphorus, and copper while retaining the current high level of water quality treatment performance for other stormwater pollutants of concern that has been demonstrated in regional BSM research.

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Bioretention Performance

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Curtis Hinman is a Senior Scientist with Herrera Environmental Consultants. Curtis has 20 years of professional experience focused on stormwater and water resources management. Mr. Hinman is a leader and entrepreneur in developing new and innovative stormwater management programs based on his recent work at Washington State University focused on low impact development. He is recognized nationally as a low impact development expert and dedicated to finding practical solutions for protecting our fresh and marine waters. He was faculty with Washington State University Extension and the Department of Biological Systems Engineering, and was the University's Green Stormwater Infrastructure Specialist. Curtis was the co-designer and lead scientist for the WSU Low Impact Development (LID) Research Program, which is one of the largest LID research facilities in the U.S. Hinman is the author of the "Low Impact Development Technical Guidance Manual for Puget Sound" and the "Rain Garden Handbook for Western Washington Homeowners." Curtis also serves on national and regional advisory committees that develop stormwater management policy, technical guidelines and identify funding and research needs. He holds an M.S. in Environmental Studies (concentration in watershed ecology and management), Yale School of Forestry and Environmental Studies (1997) and a B.S. in Environmental Policy Analysis and Planning (specializations in lake ecology, water resource management, laws, and institutions), University of California at Davis (1994).

John Lenth is a Principal Scientist with Herrera Environmental Consultants. John has 18 years of experience in water resource science, planning, and management. As the director for Herrera's water practice area, John oversees a team of collaborative scientists and engineers with expertise in low impact development design, water and sediment quality assessments, and hydrologic monitoring and modeling. John has successfully managed numerous water resource projects involving a wide range of disciplines including: monitoring, modeling, engineering design, data analysis and interpretation, and policy review and development. He has excellent people and communication skills which he uses to effectively manage projects with large, multi-disciplinary technical teams. John has broad experience working with public and private clients to apply and interpret water quality related regulations in the following areas: state and federal water quality standards; NPDES permit compliance; TMDL studies; AKART engineering analyses and related mixing zone studies; and SEPA/NEPA environmental review. He has also designed and implemented numerous studies to characterize stormwater pollutant concentrations from various land uses and the effectiveness of related control measures. With this background, John is actively involved in efforts to develop stormwater management policies at both the state and national level. John has an M.S. in Environmental Science, Huxley College, Western Washington University (1995), with a B.A. in English, Seattle University (1988).

Andy Rheaume is a watershed ecologist for the City of Redmond, Washington, and has been in the field of stormwater management and urban watershed restoration for 15 years. Andy has managed various in-stream and stormwater quality projects including measuring the effectiveness of full scale rain gardens at reducing stormwater pollution. During his career Andy has also worked on flood plain management, super fund clean-up sites, environmental policy and code, stormwater management engineering design, stormwater regulations, regional stormwater retrofit planning/funding, source control, environmental law enforcement, and more. Andy has held public office as a Bothell City Council Member for the past four years and earned a BS in Environmental Science from the University of Washington.

CWA Rule Injunction

"WATERS OF THE US" DEFINITION

PRELIMINARY INJUNCTION STOPS APPLICATION OF NEW EPA/ARMY CORPS RULE

by David Moon, Editor

INTRODUCTION

Definitional Rule

Rule Intent

The Clean Water Rule was published June 29, 2015 in the Federal Register by the US Department of the Army, Corps of Engineers (Corps) and the US Environmental Protection Agency (EPA). The final Rule "is a definitional rule that clarifies the scope of 'waters of the United States' consistent with the Clean Water Act (CWA), Supreme Court precedent, and science." 80 Fed. Reg. 37054. The overall intent of the Rule was set out at 80 Fed. Reg. 37054: "The rule will ensure protection for the nation's public health and aquatic resources, and increase CWA program predictability and consistency by clarifying the scope of 'waters of the United States' protected under the Act." In the Executive Summary, EPA also noted, "[T]his rule makes the process of identifying waters protected under the CWA easier to understand, more predictable, and consistent with the law and peer-reviewed science, while protecting the streams and wetlands that form the foundation of our nation's water resources." *Id*. For additional information concerning EPA's viewpoint of the new Rule and how it differs from previous regulation, see Water Briefs, *TWR* #136.

PRELIMINARY INJUNCTION GRANTED AGAINST RULE

Injunction Granted

On August 27, US District Judge Ralph Erickson granted a preliminary injunction, requested by North Dakota and 12 other states, which stops the EPA and the Corps from implementing its Clean Water Rule (Rule). *North Dakota, et al. v. EPA, et al*., No. 3:15-cv-59 (D. N. Dak.), August 27, 2015. EPA and the Army Corps of Engineers had been preparing to implement the Rule on its effective date of August 28. As a preliminary injunction, Erickson's ruling will last as long as the litigation continues; the states' challenge to the rule itself still needs to be briefed, argued, and decided by the courts, but the injunction will maintain the status quo until the case is fully decided. The 13 states exempted from the Rule currently are Alaska, Arizona, Arkansas, Colorado, Idaho, Missouri, Montana, Nebraska, Nevada, New Mexico, North Dakota, South Dakota and Wyoming. The Rule was designed to clear up the considerable uncertainty which exists in regard to the proper definition of "Waters of the United States" — since that phrase determines the extent of the Clean Water Act's jurisdiction over water in the US. *See Rapanos v. United States*, 547 U.S. 715 (2006).

Court's Findings

Judge Erickson agreed with the 13 states' argument that the Rule should be delayed during the on-going litigation, finding that "the States are likely to succeed on their claim because (1) it appears likely that the EPA has violated its Congressional grant of authority in its promulgation of the Rule at issue, and (2) it appears likely the EPA failed to comply with APA [i.e., federal Administrative Procedures Act] requirements when promulgating the Rule." *Slip Op*. at 2.

Extent of the Injunction — 6th Circuit's Jurisdiction Issue

6th Circuit Consolidation

Jurisdiction Questions

The controversy at the time *The Water Report* went to press — in addition to the ultimate issue of the rule's validity — is whether or not Judge Erickson's preliminary injunction applies to all 29 states that sued to prevent the Rule from going into effect. Judge Erickson has decided to allow the parties in the case before his court to submit briefs on whether or not his ruling applies to the other states not directly involved in the lawsuit filed in North Dakota's federal district court. Twenty-nine states total, plus other private parties representing irrigators, energy, developers, and others, have also sued the federal government over implementation of the rule. The cases were consolidated into one lawsuit before the 6th Circuit Court of Appeals (6th Circuit) in Cincinnati, but Judge Erickson found that he could still issue the injunction in his court despite the consolidation and the issue of the jurisdiction of the 6th Circuit. The court's analysis of this issue — whether the Court of Appeals' has "exclusive jurisdiction" over the issues involved in this case or whether (Judge Erickson's) federal district court also has jurisdiction — is contained at pages 3-6 of the *Slip. Opinion*.

EPA issued a statement shortly after the ruling noting that, "[T]his week, United States District Courts in Georgia and West Virginia agreed with the Agencies [EPA and the Corps of Engineers] that legal challenges to the Rule could only be brought in the United States Court of Appeals for the 6th Circuit and therefore denied the requests for preliminary injunction." EPA went on to state its view of the extent of the ruling by Judge Erickson: "Under the order issued by the District Court of North Dakota, the parties that

CWA Rule Injunction

Rule Opposition

Increase in Control

Cost/Benefit Analysis

Court's Balancing

Federal Power Risk

Jurisdictional Rulings

Validity Issue

obtained the preliminary injunction are not subject to the new rule, and instead continue to be subject to the prior regulation. In light of the order, EPA and the Army Corps of Engineers will continue to implement the prior regulation in the following States: Alaska, Arizona, Arkansas, Colorado, Idaho, Missouri, Montana, Nebraska, Nevada, New Mexico, North Dakota, South Dakota, and Wyoming."

Irreparable Harm

The states opposing the Rule that requested the injunction maintain that the regulation is unnecessary, infringes on state's authority, and that it will produce irreparable economic harm. Following Judge Erickson's ruling, North Dakota Attorney General Wayne Stenehjem noted in his August 27th press release, "I am very pleased by today's ruling, which protects the state and its citizens from the serious harm presented by this unprecedented federal usurpation of the state's authority." The request for a preliminary injunction alleged that the Rule unlawfully expands federal jurisdiction over state land and water resources beyond the limits specified by the Clean Water Act.

In support of the determination that there will likely be "irreparable harm" caused by the Rule, Judge Erickson cited an EPA estimate: "[W]hile the exact amount of land that would be subject to the increase is hotly disputed, the agencies admit to an increase in control over those traditional state-regulated waters of between 2.84 to 4.65 percent." Citing Federal Register, June 29, 2015, 80 Fed. Reg. 37101. *Slip Op*. at 16, footnote 65. The cited material was part of an analysis of "Economic Impacts" by EPA in the Federal Register on the costs and benefits estimated as a result of the rule; the exact citation is as follows: "Compared to a baseline of recent practice, the agencies assessed two scenarios. Those scenarios result in an estimated increase of between 2.84 and 4.65 percent in positive jurisdictional determinations annually." Thus, EPA found that the Rule would result in an increase in situations where waters would be found to be subject to the jurisdiction of the Clean Water Act.

This language cited by Judge Erickson was part of the "key conclusions" made by EPA in its economic analysis. In the cited Federal Register announcement, EPA immediately followed the language concerning the "2.84 and 4.65 percent" jurisdictional increase by pointing out that the benefits of the increase would significantly outweigh the costs: "The agencies' analysis indicates that for both scenarios, the change in benefits of CWA programs exceed the costs by a ratio of greater than 1:1. The economic analysis estimates that incremental annual costs for scenario 1 will range from $158M– $307M and incremental annual benefits will range from $339M–$350M and, for scenario 2, costs will range from $237M–$465M and benefits will range from $555M–$572M." Federal Register at 37101. Judge Erickson's Order did not refer to this cost/benefit analysis.

At the end of the Order, Judge Erickson explained his decision in general. "The court acknowledges that implementation of the Rule will provide a benefit to an important public interest, both in providing some protection to the waters of the United States and because it would provide increased certainty as to what constitutes jurisdictional waters as some people will be categorically removed from the definition of waters of the United States (for example owners of an intermittent wetland 4,001 feet away from an established tributary). The benefit of that increased certainty would extend to a finite and relatively small percentage of the public. A far broader segment of the public would benefit from the preliminary injunction because it would ensure that federal agencies do not extend their power beyond the express delegation from Congress. A balancing of the harms and analysis of the public interest reveals that the risk of harm to the States is great and the burden on the Agencies is slight." *Slip Op*. at 17-18.

CONCLUSION

Judge Erickson can be expected to rule soon as to the scope of the preliminary injunction he granted and whether or not it also applies to the other 16 states that opposed the Rule. The 6th Circuit assumedly will also weigh in on this jurisdictional question and whether a preliminary injunction should be granted.

Regardless of the decisions over preliminary injunctions, however, the battle over the validity of the Rule and the proper definition of "Waters of the United States" will undoubtedly continue in the courts. Given the huge gap between the positions of the EPA/Corps and the opposition to the Rule one can expect the final arbiter will once again be the US Supreme Court. The Supreme Court probably doesn't want to revisit *Rapanos*, but at this juncture there appears to be no alternative.

For Additional Information:

Judge Erickson's Order available at: www.ag.nd.gov/NewsReleases/2015/PI%20Order.pdf
EPA website: www.epa.gov/cleanwaterrule
Rule available at: www.gpo.gov/fdsys/pkg/FR-2015-06-29/pdf/2015-13435.pdf

WATER BRIEFS

SAN JOAQUIN SINKING CA
NASA SUBSIDENCE STUDY

As Californians continue pumping groundwater in response to the historic drought, the California Department of Water Resources (CDWR) released a report prepared for CDWR by researchers at the National Aeronautics and Space Administration's (NASA's) Jet Propulsion Laboratory. The Report documents that land in the San Joaquin Valley is sinking faster than ever before, nearly two inches (five centimeters) per month in some locations. *Progress Report: Subsidence in the Central Valley, California (August 19, 2015).* Because of increased pumping, groundwater levels are reaching record lows — up to 100 feet (30 meters) lower than previous records.

Sinking land, known as subsidence, has occurred for decades in California because of excessive groundwater pumping during drought conditions, but the new NASA data show the sinking is happening faster. NASA obtained the subsidence data by comparing satellite images of Earth's surface over time. Land near Corcoran in the Tulare basin sank 13 inches in just eight months — about 1.6 inches per month. One area in the Sacramento Valley was sinking approximately half-an-inch per month, faster than previous measurements.

The increased subsidence rates have the potential to damage local, state and federal infrastructure, including aqueducts, bridges, roads and flood control structures. Long-term subsidence has already destroyed thousands of public and private groundwater well casings in the San Joaquin Valley. "Subsidence is directly impacting the California Aqueduct, and this NASA technology is ideal for identifying which areas are subsiding the most in order to focus monitoring and repair efforts," said JPL research scientist and study co-author Cathleen Jones. CDWR also completed a recent land survey along the Aqueduct — which found 70-plus miles in Fresno, Kings and Kern counties sank more than 1.25 feet in two years — and will now conduct a system-wide evaluation of subsidence along the California Aqueduct and the condition of State Water Project facilities. The evaluation will help the department develop a capital improvement program to repair damage from subsidence.

Over time, subsidence can also permanently reduce the underground aquifer's water storage capacity.
For info: Report available at: water.ca.gov/groundwater/docs/NASA_REPORT.pdf; Ted Thomas, CDWR, 916/ 653-9712 or Ted.Thomas@water.ca.gov; Alan Buis, NASA, 818/ 354-0474 or Alan.buis@jpl.nasa.gov

INSECTICIDES STUDY US
USGS ON NEONICOTINOIDS/BEES

USGS discovered insecticides known as neonicotinoids in a little more than half of both urban and agricultural streams sampled across the US and Puerto Rico, according to a study by the agency published August 18th in Environmental Chemistry. This study — "*First National-Scale Reconnaissance of Neonicotinoid Insecticides in Streams across the USA*" — was conducted from 2011 to 2014. It represents the first national-scale investigation of the environmental occurrence of neonicotinoid insecticides in agricultural and urban settings. The research spanned 24 states and Puerto Rico and was completed as part of ongoing USGS investigations of contaminant levels in streams.

"In the study, neonicotinoids occurred throughout the year in urban streams while pulses of neonicotinoids were typical in agricultural streams during crop planting season," said USGS research chemist Michelle Hladik, the report's lead author. "The occurrence of low levels in streams throughout the year supports the need for future research on the potential impacts of neonicotinoids on aquatic life and terrestrial animals that rely on aquatic life," said USGS scientist Kathryn Kuivila, the research team leader.

Scientists and others have raised concerns about potential harmful effects of neonicotinoids on non-target insects, especially pollinating honey bees and native bees. In May, the White House released the *Strategy to Promote the Health of Honey Bees and Other Pollinators*, which includes a Pollinator Research Action Plan (*see* www.whitehouse.gov/blog/2015/05/19/announcing-new-steps-promote-pollinator-health). "This research will support the overall goals of the Strategy, by helping to understand whether these water-borne pesticides, particularly at the low levels shown in this study, pose a risk for pollinators," said Mike Focazio, coordinator for the USGS Toxic Substances Hydrology Program.

At least one of the six neonicotinoids tested by USGS researchers was found in more than half of the sampled streams. No concentrations exceeded EPA's aquatic life criteria, and all detected neonicotinoids are classified as not likely to be carcinogenic to humans. Detections of the six neonicotinoids varied: imidicloprid was found in 37 percent of the samples in the national study, clothianidin in 24 percent, thiamethoxam in 21 percent, dinotefuran in 13 percent, acetamiprid in 3 percent, and thiacloprid was not detected. Use of neonicotinoids to control pest insects has been increasing over the past decade, especially on corn and soybeans. Much of this increase is due to a shift from leaf applications to using the insecticides prophylactically on seeds.
For info: Michelle Hladik, USGS, 916/ 278-3183 or mhalik@usgs.gov; Mike, Focazio, 703/ 648-6808 or mfocazio@usgs.gov; USGS Environmental Health website: www.usgs.gov/envirohealth/

PESTICIDES TRENDS US
RIVER CONCENTRATIONS

On August 26, USGS released a new study entitled "*Trends in Pesticide Concentrations and Use for Major Rivers of the United States*," by Karen Ryberg and Robert Gilliom. According to the study, trends in pesticide concentrations in 38 major rivers in the US during 1992-2010 reflect large-scale trends in pesticide use and regulatory changes. More than 400 pesticides are used in agriculture each year. Regulatory changes, market forces, and introduction of new pesticides continually alter the use of these pesticides over time.

The study, the first to rigorously compare riverine pesticide concentrations with trends in pesticide use at the national scale, examined 11 pesticides that have sufficient historical data for trend analyses and that are among the top 20 most frequently detected in rivers and streams in the US. Most of the 11 long-used chemicals had primarily downward trends in concentrations in most regions over the study period. Focusing on this

WATER BRIEFS

group of 11 pesticides with the most extensive concentration data affords a unique opportunity to study the relations between river concentrations and use or other factors that may influence trends.

Trends in pesticide concentrations followed agricultural usage patterns and regulatory restrictions on use for pesticides used primarily on agricultural crops — cyanazine, alachlor, atrazine (and its degradate, deethylatrazine), metolachlor, and carbofuran. "In major river basins, the overall influence of agricultural pesticide use is so strong," said Karen Ryberg, USGS statistician and lead of the study, "that any changes in other causes of trends in pesticide concentrations in the water — changes that might be traced to enhanced agricultural management practices — are difficult to discern, especially without improved data on both the use of specific pesticides and the timing, location, and extent of management practices." Alachlor concentration trends in major rivers, for example, declined nationwide from 1992-2010 as the use of alachlor, a herbicide most commonly applied to corn, dropped from about 20,000 to 2,500 metric tons. The introduction of a new herbicide (acetochlor) and the increase in use of glyphosate-resistant corn and soybeans contributed to the nationwide decline in alachlor use.

For pesticides with substantial use in both agricultural and urban areas — simazine, chlorpyrifos, malathion, diazinon, and carbaryl — pesticide concentration trends in major rivers reflect both agricultural and nonagricultural usage patterns. Urban contributions of pesticides have marked effects on concentration trends of some pesticides in major rivers, despite there being a much smaller area of urban land compared to agriculture in most river basins.

The USGS National Water-Quality Assessment Program currently monitors less than half of the pesticides currently being used for agriculture because of resource constraints. However, USGS is working to fill these gaps by monitoring new pesticides that come into use, such as the neonicotinoid and pyrethroid insecticides (*see* article above).
For info: Karen Ryberg, 701/ 250-7422 or kryberg@usgs.gov; Study available at: http://water.usgs.gov/nawqa/pnsp/MajorRiverTrends.STOTEN.2015.pdf

DROUGHT RESILIENCY WEST PROJECTS SELECTED

On August 12, US Bureau of Reclamation Commissioner Estevan López announced the selection of 23 projects to receive grants totaling $5.2 million for proactive drought planning and other efforts to build long-term drought resiliency in nine states in the West. Using a competitive process, Reclamation selected 12 drought resiliency projects and 11 drought contingency planning projects in the states of Arizona, California, Colorado, Idaho, Nevada, Oklahoma, Oregon, Texas, and Washington. The new Drought Response Program supports a proactive approach to drought. It will provide assistance to water users for drought contingency planning, including consideration of climate change information and to take actions that will build long-term resiliency to drought. "Drought resiliency" refers to the capacity of a community to cope with and respond to drought.

Drought resiliency projects are also referred to as "mitigation actions." Drought Resiliency Projects must meet one of the following goals: increase the reliability of water supply; improve water management and increase operational flexibility; implement systems to facilitate voluntary sale, transfer or exchange of water; or provide benefits for fish and wildlife and the environment. The 12 drought resiliency projects will receive a total of $3.4 million, with Merced Irrigation District in California receiving $297,977 to develop a real-time simulation water management model that will help the district analyze, predict, and respond to drought conditions. The district will also install two weather stations and two river gage stations to collect water supply data on precipitation, flows, temperature, and system losses.

Drought contingency plans help communities recognize drought in its early stages, identify the effects of drought, and conduct drought prevention activities. Reclamation selected 11 drought contingency planning projects to receive a total of $1.8 million. In California, $200,000 is going to the East Bay Municipal Utility District for the Bay Area Regional Reliability Drought Contingency Plan. The utility district will work with other regional water management agencies within the Bay Area to develop a drought contingency plan to improve water supply reliability during times of shortage.

The drought response program is part of the Department of the Interior's WaterSMART Program, which focuses on improving water conservation and sustainability, while helping water resource managers make sound decisions about water use.
For info: Avra Morgan, USBR, 303/ 445-2906 or aomorgan@usbr.gov; Drought Response Program at: www.usbr.gov/drought; WaterSMART Program at: www.usbr.gov/watersmart

POLICY CHALLENGE CA WATER INNOVATION CONTEST

Imagine H2O, an organization focussed on accelerating water innovation, announced its 2015 California Water Policy Challenge on August 12th. The Challenge aims to identify policy approaches that help California's cities, farms and industries deploy water technologies. The winning entry will receive up to $25,000 in support to develop winning policy idea.

According to a recent UC Davis study, California's drought has already resulted in an estimated $2.7 billion in lost revenue and 18,600 lost jobs. Water available to agriculture in 2015 will be 67% below average. Policy that enables the deployment of water technology can not only address the state's water challenge, but also create new economic opportunities, now and in the future. Imagine H2O will work with some of the state's leading water experts to identify policy ideas that effectively balance impact and political feasibility to drive the market for water innovation.

Many of the technologies required to reduce the water intensity of California's economy already exist. The problem has been incentivizing water users to deploy them. Policy improvements could remove obstacles to using worthy water technology solutions. "California's success in renewable energy is largely a result of forward thinking policy," said Buzz Thompson, Professor at Stanford Law School and Director of the Woods Institute for the Environment who will also be judging the Challenge. "It's time California gave water the same attention it has given energy."

Winners will be determined by an independent panel of California water

leaders. Finalists will participate in a showcase event in Sacramento in early 2016 after receiving mentorship from leading water policy experts.

The Imagine H2O "Accelerator" program has helped over 60 innovative water companies win customers and receive more than $1 in every $10 of early stage financing in the water sector. **For info:** Imagine H2O's Water Policy Challenge at:www.imagineh2o.org/imagine-h2o-policy

FISH CONSUMPTION RATE WA EPA STEPS IN

EPA has proposed a rule that revises the current federal Clean Water Act human health water quality criteria applicable to waters under the State of Washington's jurisdiction. EPA states that the proposed rule would ensure that the criteria are set at levels that will adequately protect fish consumers in Washington from exposure to toxic pollutants. EPA proposes to derive the criteria using a Fish Consumption Rate of 175 g/day. The cancer risk level remains at the currently established 10^{-6} or one-in-one-million benchmark.

EPA will accept comments on the proposed rule for 60 days after it is published in the Federal Register. EPA stated that they would prefer that Washington finalize state water quality criteria that would adequately protect fish consumers in Washington. It remains EPA's strong preference to support states in their development of water quality standards to protect state waters rather than to develop standards at the national level. For background information regarding the State of Washington's efforts to address the fish consumption rate standard, *see* Water Briefs, *TWR* #128 and *TWR* #132, and Campbell, *TWR* #126.

In 1992, EPA established Washington's existing criteria for the protection of human health as part of the National Toxics Rule. EPA's proposed rule updates the fish consumption rate based on more recent regional and local fish consumption data, as well as updates the toxicity and exposure parameters used to calculate human health criteria.

If the State of Washington submits final criteria to EPA for approval under the Clean Water Act before EPA finalizes the federal human health water quality criteria, EPA will review and act upon the State's submission in a timely manner and prior to any final action on the federal criteria. If EPA approves criteria submitted by the State, the corresponding federal criteria will not be finalized.

For info: Federal Water Quality Standards for Washington: http://water.epa.gov/scitech/swguidance/standards/wqswa.cfm; Fact sheet:Proposed Revision of Federal Human Health Criteria Applicable to Washington at: http://water.epa.gov/scitech/swguidance/standards/upload/Washington-Rule-Fact-Sheet.pdf

WATER FOR SALMON OR/CA RECLAMATION STORAGE RELEASES

On August 26, Judge Lawrence O'Neill of the federal district court (Eastern District of California) denied a request for a Temporary Restraining Order against the US Bureau of Reclamation (Reclamation), regarding its release of water from Trinity Reservoir to the lower Klamath River to reduce the risk of an adult fish kill of salmon. San Luis & Delta Mendota Water Authority and Westlands Water District filed a lawsuit to stop Trinity Reservoir releases to the Klamath River, alleging that by approving and implementing the 2015 Flow Augmentation Releases (FARs), Reclamation acted in excess of existing statutory authorities; violated reclamation law by delivering water without first entering into a contract for delivery of that water that meets the requirements of reclamation law and policy; violated the National Environmental Policy Act by approving and implementing the 2015 FARs without first preparing an Environmental Impact Statement; and violated the Endangered Species Act and the Magnuson-Stevens Fishery Conservation and Management Act of 1976 by implementing the 2015 FARs without first engaging in required consultation with relevant federal wildlife agencies. *San Luis & Delta Mendota Water Authority, et al. v. Sally Jewell, et al*., Case NO. 1:15-CV-01290-LJO-GSA (August 26, 2015), page 2.

"The Court concludes that there is no clear showing of likelihood of success on the merits. Even if Plaintiffs are likely to succeed on the merits of at least one of their claims against Reclamation in connection with the 2015 FARs, the balance of the harms does not warrant an injunction at this time. The potential harm to the Plaintiffs from the potential, but far from certain, loss of added water supply in 2015 or 2016 does not outweigh the potentially catastrophic damage that 'more likely than not' will occur to this year's salmon runs in the absence of the 2015 FARs. There will be those who credit the Court for this decision, and those who will discredit the Court for this decision. Let it be understood by both camps that the Court is obligated to follow the law as it is. That has occurred, regardless of the absence or presence of the popularity of the ruling." *Id*. at 14-15.

On August 20th, Reclamation announced it would release additional water from Trinity Reservoir for the lower Klamath River to help protect returning adult fall run Chinook salmon from a disease outbreak and mortality. Continued dry hydrologic conditions and the recent discovery of the presence of Ich, the fish disease thought primarily responsible for a large fish die-off in the river in 2002, prompted Reclamation to consider supplementing flows. In July, Reclamation released a Draft Environmental Assessment for the plan to use Trinity Reservoir water for the supplemental flows. The EA also analyzed using a potential emergency volume if needed to avoid a significant die-off of adult salmon.

Releases from Lewiston Dam will be adjusted to target 2,800 cubic feet per second (cfs) in the lower Klamath River starting the week of August 20. River flow forecasts indicated that Lewiston Dam releases could increase from the rate of 450 cfs on August 21 and could range up to 1,300 cfs before dropping to 450 cfs in late September. Additional information will be provided in the event that higher peak flows are needed in early to mid-September as part of the preventative action.

Flows from Lewiston could be raised as high as 3,500 cfs for up to five days if real-time monitoring suggests a need for additional supplement flows as an emergency response. Releases could increase as quickly as 250 cfs every two hours, and flow reductions could drop as quickly as 100 cfs every four hours.

The Final Environmental Assessment and Finding of No Significant Impact for this project

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are available online at: www.usbr.gov/mp/nepa/nepa_projdetails.cfm?Project_ID=22309.
For info: Kylene Lang, USBR, 916/978-6153 or klang@usbr.gov; Order available upon request to *TWR*

EARTHQUAKES INCREASE OK WASTEWATER DISPOSAL BEING LIMITED

Faced with an unprecedented increase in earthquake activity, the Oklahoma Corporation Commission's Oil and Gas Conservation Division (OGCD) on August 3rd put in place a plan to reduce oil and gas wastewater disposal well volume in a proscribed area of northern Oklahoma County and southern Logan County. Oklahoma experienced 585 magnitude 3+ earthquakes in 2014 compared to 109 events recorded in 2013. The Oklahoma Corporation Commission (Commission) is the state's regulatory agency charged with overseeing Oklahoma's oil and gas industry, including the siting and operation of Class II underground injection wells (disposal and enhanced recovery wells).

Under the plan, operators will have a 60-day period during which volume will be reduced 38 percent, or about 3.4 million barrels under the 2014 total. Such a reduction will bring total volume for the area to a level under the 2012 total by about 2.4 million barrels. The area saw its sharpest rise in seismicity start in late 2012. This is the latest development under the "traffic light" system" adopted by the Commission, as recommended by the National Academy of Sciences, which directs staff to review disposal well permits for proximity to faults, seismicity in the area and other factors. All proposed disposal wells, regardless of location, now undergo a seismicity review.

The "traffic light" system was first put in place in 2013 in response to the concerns over the possibility of earthquake activity being caused by oil and gas wastewater disposal wells in Oklahoma. It has been in a state of constant evolution since then, as new data becomes available.
For info: Matt Skinner, OGCD, 405/521-4180 or m.skinner@occemail.com; OGCD Plan at: http://earthquakes.ok.gov/wp-content/uploads/2015/04/08-03-15LetterSeismicity_Final.pdf; see also new Earthquake website at:http://earthquakes.ok.gov/

KLAMATH REGULATION OR TIME IMMEMORIAL RIGHTS

The Klamath Tribes called for regulation in April for the Wood, Williamson, and Sprague River drainages based on their concern that specified instream flows were not being met. The priority date for those instream flows, as determined in the Klamath Basin Adjudication, is time immemorial. The Klamath Project and associated irrigation districts made a call for their 1905-priority water in mid-June. Currently, the Wood, lower Williamson, and Sprague River drainages are regulated for the 1905 Klamath Project priority, as the older instream water rights are being satisfied. Some smaller streams have been regulated to time immemorial to satisfy senior instream water rights, which include Scott Creek, Jackson Creek, Irving Creek, Deep Creek, and Whiskey Creek.

In May 2015, the Klamath Tribes for the first time made a call to satisfy an adjudicated claim on the Klamath Marsh. The claim identifies a minimum water elevation each month to be maintained on the marsh with a priority date of time immemorial. The watermaster verified the call and all uses around the lake, excepting some stockwater uses, have been regulated off.

The stockwater uses were not regulated off due to temporary rules adopted by the Oregon Water Resources Commission (Commission) in May 2015 that allow a preference for human consumption water and stockwater in the Klamath Basin. To take advantage of the stockwater preference, those rules require that a water user must have a water right for stockwater and provide notice to the watermaster of the intention to utilize the preference. During the 2015 irrigation season, the watermaster received 39 stockwater notices in the Klamath Basin.

This information was provided in a Memorandum from Thomas Byler, Director, Oregon Water Resources Department (OWRD), for the September 11, 2015 Commission Meeting, Agenda Item G.
For info: Staff Report available at OWRD website: http://apps.wrd.state.or.us/apps/misc/wrd_notice_view/Default.aspx?notice_id=41

TURF & TOILETS CA REBATE PROGAMS

On August 12, the California Department of Water Resources (CDWR) announced two new rebate programs to help Californians replace inefficient toilets and tear out water-guzzling lawns, further conserving water during the state's historic drought. The "turf and toilet" rebate program is financed by the Proposition 1 water bond approved by voters in 2014. The program will help carry out Governor Brown's April 1 Executive Order on Drought to further reduce water use in homes by replacing more than 10 million square-feet of lawn and upgrading more than 60,000 water-wasting toilets.

With $24 million in Proposition 1 funding, the turf replacement program will rebate $2 per square foot of turf replaced, up to $2,000 per household through state or local turf replacement programs. Consumers are eligible to replace turf that is living or dead at the time of the rebate application. (Bare earth areas with no sign of turf are not eligible for a rebate.) The turf rebate program is estimated to benefit more than 10,000 homes, with a focus on disadvantaged communities hardest hit by the drought. $12 million of the lawn removal funds is targeted for residents in disadvantaged communities in areas with depleted groundwater basins. The turf program will be monitored by CDWR and administered by the Electric & Gas Industries Association.

The $6 million toilet rebate program, also funded through Proposition 1, will help Californians replace approximately 60,000 old, inefficient toilets by offering a $100 customer rebate per household to replace with a high-efficiency toilet.
For info: Kent Frame, CDWR, 916/651-7055 or Kent.Frame@water.ca.gov; Apply for Rebates at: www.SaveOurWaterRebates.com; Drought Actions at:Dought.CA.Gov

SEDIMENT CLEANUP WA PENALTIES ISSUED

On August 26, EPA announced that nine months after issuing its Duwamish Waterway cleanup plan, the agency is proposing penalties of $367,500 for seven separate violations of the cleanup agreement between EPA and Earle M. Jorgensen Company (EMJ)

that occurred between July 2014 and July 2015. EPA asserts that when EMJ removed and transported creosote pilings and PCB-laden sediments from the Jorgensen Forge cleanup site, EMJ and its contractors repeatedly failed to meet necessary and agreed-upon cleanup requirements and presented unnecessary risks to human health and the environment during the cleanup.

Sediment cleanup work in a working river is complicated, so EPA builds Best Management Practices (BMPs) into the workplans that are developed for each cleanup site to prevent release of contaminated material during cleanup work. Following these BMPs helps companies and their contractors get the job done correctly and safely. Conversely, failure to do the work as required by the cleanup agreement and the BMPs detailed in the agreement, can lead to release of contaminants during cleanup activities which may have adverse impacts to human health and the environment.

Throughout the construction activities, EPA and the Army Corps of Engineers observed and documented multiple violations of the cleanup agreement between EMJ and EPA. Many of the violations were discovered by EPA and the Corps, despite EMJ representatives being on-site at that time ostensibly to ensure that the work was being performed consistent with the cleanup agreement. For example, last year EMJ's contractors repeatedly failed to use BMPs for pilings removal and sediment management and failed to take samples of sediments, as required, to determine if they'd actually cleaned up the site. EPA's project manager called attention to the workplans — and BMPs that should have guided the work — but was typically ignored.

For info: Bill Dunbar, EPA, 206-553-1019

TREATMENT AS A STATE US TRIBAL WATER QUALITY AUTHORITY

Waters on the majority of Indian reservations do not have water quality standards under the Clean Water Act to protect human health and the environment. Only 40 of over 300 federally recognized tribes with reservations have obtained the EPA's approval to be treated in a manner similar to a state ("**t**reatment **a**s a **s**tate" or TAS) and adopted standards for their waters that EPA has approved. [*See* Du Bey & Rosenthal, *TWR* #18.]

EPA proposes that section 518 of the Clean Water Act include an express delegation of authority for eligible tribes to regulate under the Act. This proposal, if finalized, would streamline how tribes apply for TAS for the water quality standards program and other Clean Water Act regulatory programs. EPA is accepting public comments on the proposal through October 6, 2015.

For info: EPA website at: http://water.epa.gov/scitech/swguidance/standards/wqslibrary/tribal.cfm

RESERVOIR RELEASE CO LEASE AGREEMENT

On September 2, the Colorado Water Conservation Board (CWCB) initiated release of water from Ruedi Reservoir for the month of September to benefit endangered fish in the Colorado River Basin. CWCB entered into a lease agreement with the Ute Water Conservancy District (UWCD) on August 31 for water stored in Ruedi Reservoir, located on the Fryingpan River near Basalt, to supplement flows for existing instream flow water rights on the Colorado River.

CWCB approved the Water Lease Agreement with UWCD during a regular CWCB Board meeting in May 2015. This agreement allows CWCB to lease between 6,000 acre-feet and 12,000 acre-feet of water from Ruedi Reservoir for instream flow use on the 15-Mile Reach of the Colorado River, located near Palisade, Colorado. No releases will result in overall flows from Ruedi exceeding 300 cfs.

The so-called 15-Mile Reach provides critical spawning habitat for the following endangered fish: Colorado pikeminnow, razorback sucker, humpback chub, and bonytail. It was determined that the water would be best utilized to preserve the natural environment at rates up to and exceeding the current instream flow rights to meet US Fish and Wildlife Service flow targets for the four endangered fish species in the reach.

"These types of 'win-win' agreements are needed to assure that Colorado can beneficially use water within Colorado and help recover endangered fish that use the Colorado River for habitat," said James Eklund, Director of the CWCB.

The UWCD was established in 1965 for the purpose of supplying domestic water service to rural areas of the Grand Valley, encompassing roughly 260 square miles and servicing over 80,000 people. The UWCD originally entered into a Repayment Contract with the US Bureau of Reclamation in September 2013, through which it purchased 12,000 acre-feet of water annually from Ruedi Reservoir. By entering into this lease, CWCB has access to this water on a short-term basis for the benefit of the four endangered fish species. Water released from Ruedi Reservoir under this lease will also be available for non-consumptive power generation immediately above the reach, providing additional late summer benefits to the local area.

"This is the first time that the Species Conservation Trust Fund has been used to purchase stored water to supplement flows to critical habitat for endangered fish. We are excited that we have been able to use this particular funding source and our instream flow program for this purpose," said Linda Bassi, Chief of the Stream and Lake Protection Section of CWCB. CWCB currently holds two instream flow water rights on the reach.

"Colorado has always been on the leading edge of balancing the development of water resources with recovery of endangered species, and this lease is another example of how Colorado has been able to creatively balance those competing interests," said Ted Kowalski, Chief of the Interstate, Federal & Water Information Section of CWCB.

The CWCB has already coordinated with a variety of stakeholders within the affected reaches to implement the releases of this water from Ruedi Reservoir. This coordination will continue throughout the month of September.

For info: Linda Bassi, CWCB, 303/ 866-3441 x3204 or CWCB website: http://cwcb.state.co.us/pages/CWCBHome.aspx

CALENDAR

September 17 CA
Science of Water & Law in California Seminar, Santa Monica. DoubleTree Suites Santa Monica. For info: Law Seminars Int'l, 800/ 854-8009, registrar@lawseminars.com or www.lawseminars.com

September 17 CA
Draft Environmental Impact Statement Re: Central Valley Project & State Water Project (Meeting), Irvine. Hilton Hotel/Orange County Airport, 18800 MacArthur Blvd., 6-8 pm. Presented by Bureau of Reclamation. For info: www.usbr.gov/newsroom/newsrelease/detail.cfm?RecordID=49902

September 17-18 CA
12th Biennial State of the San Francisco Estuary Conference, Oakland. Oakland Marriott at City Center. Presented by San Francisco Estuary Partnership. For info: www.sfestuary.org/soe/

September 18 CA
California Environmental Quality Act Seminar, Santa Monica. DoubleTree Suites Santa Monica. For info: Law Seminars Int'l, 800/ 854-8009, registrar@lawseminars.com or www.lawseminars.com

September 18 OR
Oregon Environmental Cleanup Conference: Remediation, Restoration & Redevelopment, Portland. World Trade Center Two, 25 SW Salmon Street. For info: Environmental Law Education Center, 503/ 282-5220, hduncan@elecenter.com or www.elecenter.com

September 18 OR
Salmon Homecoming Hootenany, Medford. Eden Vale Winery. Presented by WaterWatch of Oregon. For info: https://waterwatch.ejoinme.org/hootenanny

September 21-22 ID
Water Law in Idaho Seminar, Boise. Red Lion Hotel Downtowner. For info: Law Seminars Int'l, 800/ 854-8009, registrar@lawseminars.com or www.lawseminars.com

September 21-25 Germany
FEFLOW 2015: Modeling the World of Groundwater with MIKE by DHI, Berlin. For info: www.feflow.com/feflow2015

September 22 AZ
Navajo Solar Desalination Demonstration Project - Brownbag Seminar, Tucson. WRRC Sol Resnick Conference Rm, 350 N. Campbell Ave. Presented by Water Resources Research Ctr. For info: http://wrrc.arizona.edu/events/brownbag

September 22-23 WY
Upper Great Plains Groundwater Conference, Cheyenne. Little America Hotel. Presented by Nat'l Groundwater Ass'n. For info: www.ngwa.org/Events-Education/conferences/Pages/5010sep15.aspx

September 22-23 CA
Water Innovation Summit, Berkeley. The Claremont Hotel Club & Spa. Hosted by the Cleantech Group. For info: http://events.cleantech.com/waterinnovationsummit/

September 22-23 TX
TCEQ 2015 Water Quality/Stormwater Seminar, Austin. DoubleTree Hotel. For info: www.tceq.texas.gov/p2/events/stormwater.html

September 24 WA
Model Toxics Act Seminar, Seattle. Hotel 1000 Seattle. For info: Law Seminars Int'l, 800/ 854-8009, registrar@lawseminars.com or www.lawseminars.com

September 24-25 CA
3rd Annual Endangered Species Act Conference, San Francisco. Hotel Nikko, 222 Mason Street. For info: CLE Int'l, 800/ 873-7130 or www.cle.com

September 25 OR
Drought in the American West: Symposium on Law, Policy & Science, Eugene. UO Knight Law Center. Presented by UO's Journal of Environmental Law & Litigation, Oregon Review of International Law and Environmental & Natural Resources Law Center. For info: http://law.uoregon.edu/explore/enr

September 26-30 IL
WEFTEC 2015: The Water Quality Event & Exhibition, Chicago. McCormick Place South. Presented by Water Education Foundation. For info: www.weftec.org/future-weftec-schedule/

September 27-30 OK
2015 Ground Water Protection Council Annual Forum: Where Water & Energy Mix, Oklahoma City. Courtyard by Marriott-Bricktown. For info: www.gwpc.org/events/2015-annual-forum

September 30 TX
Pollution Prevention Waste Management Workshop, Austin. J.J. Pickle Center - UT Austin. Presented by TCEQ. For info: www.tceq.texas.gov/p2/events/pollution-prevention-waste-management-workshop

September 30-Oct. 1 TX
Texas Desal 2015: Innovation & Reliability, Austin. Radisson Hotel Downtown. For info: www.texasdesal.com/events/2015-conference.html

September 30-Oct. 1 CA
Industrial Stormwater Compliance Workshop, San Francisco. UC Berkeley - San Francisco Campus. For info: UC Berkeley Extension, http://extension.berkeley.edu/search/publicCourseSearchDetails.do?method=load&courseId=18089818&utm_source=flyer&utm_medium=flyer&utm_campaign=from-david

October 1 WA
Toxics Conference: Emerging Contaminants, Fish Consumption Rates & Water Quality Standards, Seattle. Washington State Convention Ctr. For info: Environmental Law Education Center, 503/ 282-5220, hduncan@elecenter.com or www.elecenter.com

October 1-2 CA
CalDesal's 4th Annual Conference, Ontario. DoubleTree Ontario Airport. For info: www.caldesal.org/Events.php

October 2 AZ
Groundwater Remediation Project Approach to Water Treatment - Brownbag Seminar, Tucson. Water Resources Research Ctr. Presented by WRRC. For info: http://wrrc.arizona.edu/events/brownbag

October 5 UT
Utah Water Law Conference, Salt Lake City. Marriott Downtown at City Creek. For info: CLE Int'l, 800/ 873-7130 or www.cle.com

October 5-6 TX
Texas Water Law Conference, Austin. Omni Hotel at Southpark. For info: CLE Int'l, 800/ 873-7130 or www.cle.com

October 5-6 CA
Finding "New" Water: Evaluating "New" Water Options for Overcoming Drought & Diversifying Water Portfolios Conference, Anaheim. DoubleTree Anaheim Resort. For info: Law Seminars Int'l, 800/ 854-8009, registrar@lawseminars.com or www.lawseminars.com

October 5-8 AZ
13th Biennial Conference of Science & Management on the Colorado Plateau & Southwest Region, Flagstaff. Northern Arizona University. For info: http://nau.edu/Merriam-Powell/Biennial-Conference/

October 5-7 TX
SXSW Eco Conference, Austin. Austin Convention Ctr. For info: http://sxsweco.com/

October 6-8 CO
2015 Sustaining Colorado Watersheds Conference: In It For the Long Haul, Avon. Westin Riverfront Resort. Hosted by the Colorado Watersheds Assembly, Colorado Foundation for Water Education & Colorado Riparian Ass'n. For info: http://www.coloradowater.org/Conferences

October 6-9 CA
Pacific Water Quality Ass'n Convention & Trade Show, City of Industry. Pacific Palms Resort. For info: www.wqa.org/Programs-Services/Resources/Calendar-of-Events

October 6-9 MT
Watershed Symposium: Linking Water Research to Policy and Water Management, Missoula. Holiday Inn Downtown. Presented by Montana Watershed Coordination Council & Montana Chapter of American Water Resources Ass'n. For info: www.montanaawra.org/conference/

October 7-9 KS
WSWC Fall (179th) Council Meeting, Manhattan. Bluemont Hotel. For info: Western States Water Council, www.westernstateswater.org/upcoming-meetings/

October 7-9 MT
Linking Water Research to Policy & Water Management - Joint AWRA-MWCC Meeting, Missoula. Presented by MT AWRA & Montana Watershed Coordination Council. For info: Nancy Hystad, MWC, nancy.hystad@montana.edu or http://wildfish.montana.edu/awra/

October 7-9 NV
WaterSmart Innvocations 2015 Conference & Exposition, Las Vegas. South Point Hotel & Conference Ctr. Presented by Southern Nevada Water Authority w/ EPA's WaterSense Program, Alliance for Water Efficiency, American Water Works Assoc. and leading organizations. For info: www.watersmartinnovations.com/

October 8 WA
Re-Using Contaminated Land: Transactions, Technologies & Techniques, Seattle. Hilton Seattle Airport, 17620 International Blvd. Presented by Northwest Environmental Business Council. For info: www.nebc.org/EventDetail.aspx?Id=159

October 8-9 CA
California Water Law Conference, San Francisco. BASF Conference Center. For info: CLE Int'l, 800/ 873-7130 or www.cle.com

October 13 WA
Water Law & Water Efficiencies Course: 101 on Grey Water Recycling for Homes, WEB or Woodinville. WEB or Live at 21 Acres, 13701 Northeast 171st Street. Presented by Dept. of Ecology and Cascade Water Alliance. For info: www.ecy.wa.gov/programs/wr/nwro/wtrlaw-efficiency.html

October 13-14 MT
River Restoration Course: Dynamic Streambank, Riparian & Floodplain Techniques, Bozeman. Montana State University. Presented by Montana Water Center & Montana Dept. of Environmental Quality. For info: Stephanie McGinnis, mcginnis@montana.edu

October 14 CA
ACWA's 2015 Regulatory Summit, Ontario. DoubleTree by Hilton Hotel. Presented by Ass'n of California Water Agencies. For info: http://www.acwa.com/events/acwa-2015-regulatory-summit

October 14-16 CO
Best Practices for Collaborative Water Decisions: Moving from Concept to Action Training, Palisade. Wine Country Inn. Presented by CDR Assoc. & Colorado Water Institute. For info: http://cdrassociates.org/training-opportunities

October 15-16 MT
15th Annual Montana Water Law Seminar, Helena. Great Northern Hotel. For info: The Seminar Group, 800/ 574-4852, info@theseminargroup.net or www.theseminargroup.net

October 15-16 AZ
Arizona Riparian Council 28th Annual Meeting, Flagstaff. High Country Conference Ctr. For info: www.riparian@asu.edu

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

(continued from previous page)

October 18-22 Jordan
Water Security for Sustainable Growth: Water & Development Congress & Exhibition, Dead Sea. King Hussein bin Talal Convention Ctr. Organized by the International Water Ass'n. For info: www.iwa-network.org/WDCE2015/

October 18-22 AR
17th Annual Stormwater Conference, Hot Springs. Hot Springs Convention Ctr. Presented by EPA Region 6. For info: www.epa.gov/region/water/npdes/sw/ms4/2015conference/

October 19 WA
Wetlands in Washington Seminar, Seattle. Courtyard Marriott/Pioneer Square. For info: Law Seminars Int'l, 800/ 854-8009, registrar@lawseminars.com or www.lawseminars.com

October 19-21 CA
2015 CASQA Eleventh Annual Conference, Monterey. Hyatt Regency. Presented by California Stormwater Quality Ass'n. For info: www.casqa.org/events/annual-conference

October 20 OH
Ohio Surface Water Conference, Columbus. Renaissance Downtown. For info: CLE Int'l, 800/ 873-7130 or www.cle.com

October 22 WA
AWRA Washington State Conference: Impacts of Climate Change to Water Resources & Potential Strategies, Seattle. Mountaineer's Event Center. Presented by American Water Resources Ass'n - WA Section. For info: http://waawra.org/event-1915439

October 22-23 CA
Tribal Water Law Conference - 4th Annual, San Diego. The Westin. For info: CLE Int'l, 800/ 873-7130 or www.cle.com

October 23 OR
Environmental Law: Year in Review CLE, Troutdale. McMenamin's Edgefield Manor. Presented by Environmental & Natural Resources Section - OR State Bar. For info: www.osbar.org

October 26-29 CA
VERGE: Where Tech Meeets Sustainabiity Conference, San Jose. The Fairmount Hotel. For info: www.greenbiz.com/events/verge/san-jose/2015?src=v15prtnrih2o

October 28 WA
Permitting Strategies for Large, Controversial Projects in Washington State & the Northwest Seminar, Seattle. Mayflower Park Hotel, 405 Olive Way. For info: The Seminar Group, 800/ 574-4852, info@theseminargroup.net or www.theseminargroup.net

October 29 AZ
Pumps, Pipelines & Property Rights: Legal & Political Challenges for Decentralized Groundwater Governance in Central Texas - Brownbag Seminar, Tucson. Water Resources Research Ctr. Presented by WRRC. For info: http://wrrc.arizona.edu/events/brownbag