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Water Rights, Water Quality & Water Solutions in the West

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PFAS UPDATE

PFAS RESPONSES – AN EMERGING PLAYBOOK

by Taryn McKnight, PFAS Practice Leader, Eurofins Environment Testing America (Sacramento, CA)

Introduction

Per and Polyfluoroalkyl Substances (PFAS) are in the news across the United States and are a growing topic of discussion amongst environmental practitioners and at all levels of regulatory agencies. If you have tuned in at all to the environmental news during 2018, you likely heard a lot of speculation about where we were headed in 2019. There has been a significant volume of activity over the past year, including shifting priorities, new regulations, and new research that makes some of these issues difficult to follow.

This article presents an update on recent and emerging activity, including: what are PFAS; where do they come from; how are we exposed to them; what is the involved risk; and what have we done about it.

Background

PFAS stands for Per and Polyfluoroalkyl Substances — a class of synthetic compounds which contain thousands of chemicals, all of which have at least one fluorinated carbon atom. The Organization for Economic Co-operation and Development (OECD) has cataloged 4,729 PFAS related chemicals.[1] This carbon-fluorine bond is one of the shortest and strongest bonds in nature. This bond is responsible for most of the unique and useful characteristics of these chemicals — such as heat and stain resistance and use as an effective surfactant and water repellant. Unfortunately, this bond is also what causes the undesirable characteristics, including: environmental persistence; bioaccumulation; and resistance to degradation.

PFAS Sources, Exposure & Risk

The primary sources of PFAS in the environment include manufacturing facilities. This begins with primary manufacturers of the raw materials and moves onto secondary manufacturers that incorporate the raw materials into their processes or products. One prevalent industrial product is Aqueous Film Forming Foam (AFFF). AFFF is a Class B foam used to suppress liquid hydrocarbon fires. This product was not only used during emergency responses but also for fire fighting training and equipment testing such as capacity tests and time-and-distance calibrations.[2] In addition, we have the myriad of consumer products. This is a lengthy list of items when you consider that many products with a stain resistant, water repellant, or non-stick properties are included. This list includes everything from clothing and furniture, to food wrappers and personal care products.[3]

Concerning potential exposure pathways, these include everything from industrial discharges to our air and waterways or the application of AFFF, to our waste infrastructure and those consumer goods mentioned above (***see* Figure 1,** next page). Most of our exposure to PFAS comes from food, drinking water, and dust.[4]

PFAS

Legacy Compounds

Voluntary Phase-Out

Replacement Chemicals

Health Advisory Limit

Pathways

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260 North Polk Street,
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Editors: David Light
David Moon

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

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260 North Polk Street
Eugene, OR 97402

PFAS chemicals bind to protein as opposed to fat so we find them accumulating in the blood, liver, and kidneys. Certain PFAS are associated with a number of negative health outcomes like thyroid disease, high cholesterol, impaired immune response, and reproductive issues.[5] Most of the toxicology that exists today is based off of two primary legacy compounds, Perfluorooctanoic acid (PFOA) and Perfluorooctanesulfonic acid (PFOS). These compounds were mass-produced and distributed for decades. These compounds represent the primary PFAS constituents in products such as AFFF, Scotchgard™, and Teflon™.

If there is a concern regarding human health impacts, what have we done about it? From a federal regulatory standpoint not much has happened in the US that has not been either voluntary or simply guidance. For instance, there was a voluntary phase-out of the production of the longer chain PFAS chemicals, C8 (eight carbons) and longer. This effort was mostly complete by 2015.[6]

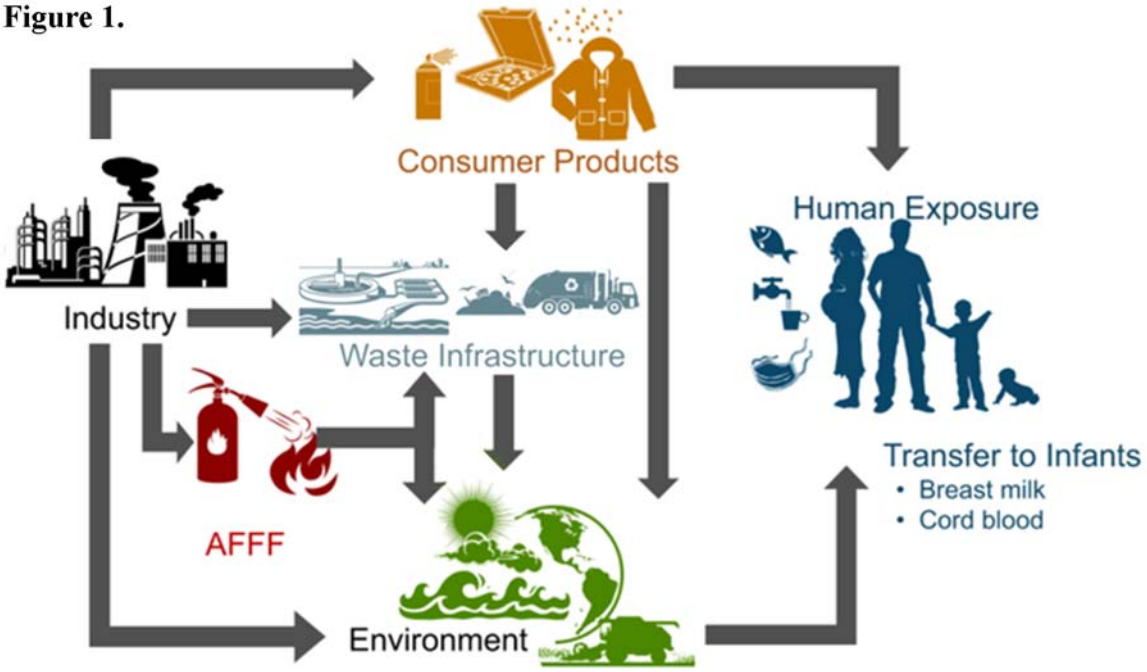
During the phase-out of production of the longer chain chemicals, the production of what have been coined "replacement chemicals" began. These replacements were largely targeted to be C6 or shorter chain PFAS chemicals — the belief being that shorter chain compounds would be safer, less persistent, less bioaccumulative and less toxic than their long chain counterparts. Unfortunately the toxicology has some catching up to do on vetting that assertion, so there is growing debate about this in our country today.[7]

Currently the US Environmental Protection Agency (EPA) has highlighted four primary replacement chemicals and taken steps to address them: Hexafluoropropylene Oxide Dimer Acid (GenX), ADONA, and F-53B Major and Minor. Bear in mind that these are just four out of hundreds of replacement chemicals. There is a draft toxicity assessment available from the EPA on the replacement chemical GenX.[8]

So, we have two paradigms at play here, the world of contamination from relatively well known legacy chemicals and the world of contamination from relatively unknown replacement chemicals.

In 2016, EPA established a lifetime health advisory limit for PFOA[9] and PFOS.[10] This is not an enforceable Maximum Contaminant Level; it is advisory or guidance. In 2018, EPA held a National PFAS Summit and by January of 2019 they had released a relatively detailed PFAS Action Plan.[11] Over the course of 2019 activity increased and a number of developments began to unfold.

Figure 1.



Adapted from Sunderland et al. (2019)
***Journal of Exposure Science & Environmental Epidemiology* 29(2). doi:10:1038/s41370-018-0094-1**

Federal Actions

PFAS Action Plan

EPA's PFAS Action Plan is a 64-page document. We are only going to touch on some of the more significant items that relate to actions during the course of 2019 and 2020.

Maybe the most pressing issue of 2019 was whether EPA would make the necessary regulatory determination under the federal Safe Drinking Water Act (SDWA) to pursue setting a Maximum Contaminant Level (MCL) for PFOA and PFOS. An MCL is a legally enforceable limit which can be used to regulate the presence of a contaminant in public drinking water systems. The process for setting an MCL for PFOA and PFOS began many years ago under the Third Unregulated Contaminant Monitoring Rule (UCMR3). Six PFAS compounds were monitored for in systems across the US serving more than 10,000 customers from 2013-2015.[12]

PFAS

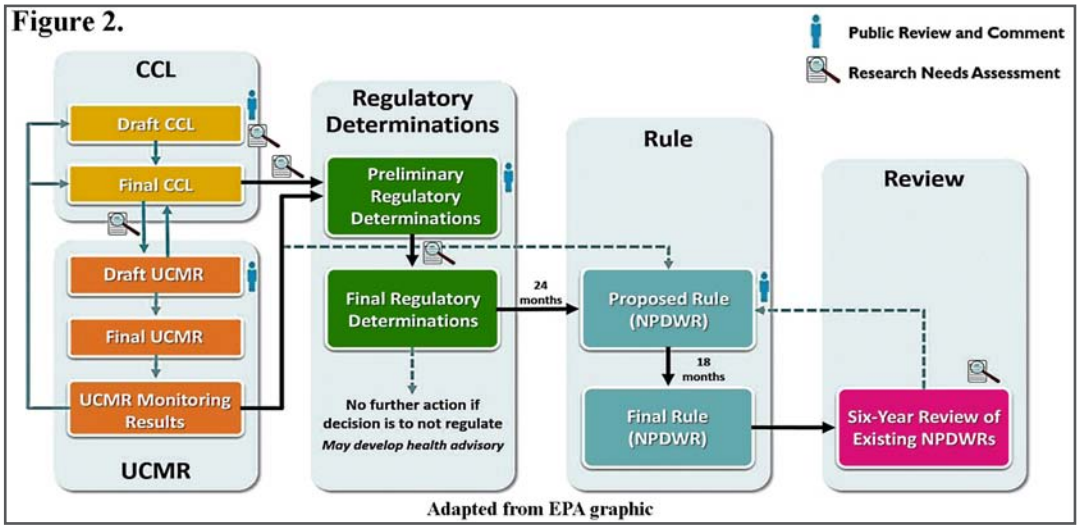
MCL Process

UCMR5 Rule

Rulemaking Process

In February 2020, EPA announced the proposal of a regulatory determination, indicating that they believe establishing an MCL for PFOA and PFOS would provide a meaningful opportunity for health risk reductions.[13] Now EPA will proceed with a multi-year rulemaking process (***see* Figure 2**). In concert with this decision, EPA announced that they intend to monitor for PFAS compounds under the fifth UCMR, (UCMR5). The proposed monitoring list is expected to include the same six PFAS compounds from UCMR3 in addition to 24 new PFAS compounds. The UCMR5 rule process begins now and the final proposal for it will be submitted during the summer of 2020. The final rule should be adopted by late 2021 and monitoring will begin in 2023.[14]

Figure 2.



Adapted from EPA graphic

Public Water Systems > 3,300

There are several interesting points to note about these current rulemakings. Due to a recent change to the SDWA, the proposed monitoring would now affect Public Water Systems serving greater than 3,300 customers as opposed to the 10,000 customer threshold that existed during UCMR3. This will also be the first time in UCMR history that EPA has monitored for the same chemicals twice. The law restricts the EPA to select no more than 30 compounds to assess under each rule. However, the National Defense Authorization Act (NDAA) included a provision excluding PFAS chemicals from counting towards this limit.[15] This effort will require two analytical methods to capture the complete list of PFAS compounds proposed within UCMR5, as opposed to the single analysis that was required to support PFAS testing under UCMR3. We see a repeat of the six compounds from UCMR3, the inclusion of several replacement chemicals, and all of the short chain chemicals under the newly published EPA method 533 (***see* Figure 3**).

Included PFAS Compounds

Figure 3.

CCL and Related Candidates for UCMR 5 (cont'd)

Draft Method 533	
1H, 1H, 2H, 2H-perfluorodecane sulfonic acid (8:2 FTS)	4,8-dioxa-3H-perfluorononanoic acid (ADONA) (537.1)
1H, 1H, 2H, 2H-perfluorohexane sulfonic acid (4:2 FTS)	Hexafluoropropylene oxide dimer acid (HFPO-DA) (537.1)
1H, 1H, 2H, 2H-perfluorooctane sulfonic acid (6:2 FTS)	Perfluorobutanesulfonic acid (PFBS) (537.1)
Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)	Perfluorodecanoic acid (PFDA) (537.1)
Perfluoro (2-ethoxyethane) sulfonic acid (PFEESA)	Perfluorododecanoic acid (PFDoA) (537.1)
Perfluoro-3-methoxypropanoic acid (PFMPA)	Perfluoroheptanoic acid (PFHpA) (537.1)
Perfluoro-4-methoxybutanoic acid (PFMBA)	Perfluorohexanoic acid (PFHxA) (537.1)
Perfluorobutanoic acid (PFBA)	Perfluorohexanesulfonic acid (PFHxS) (537.1)
Perfluoroheptanesulfonic acid (PFHpS)	Perfluorononanoic acid (PFNA) (537.1)
Perfluoropentanesulfonic acid (PFPeS)	Perfluorooctanesulfonic acid (PFOS) (537.1)
Perfluoropentanoic acid (PFPeA)	Perfluorooctanoic acid (PFOA) (537.1)
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS) (537.1)	Perfluoroundecanoic acid (PFUnA) (537.1)
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS) (537.1)	

PFAS Analytes Unique to Method 537.1	
N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	Perfluorotetradecanoic acid (PFTA)
N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	Perfluorotridecanoic acid (PFTrDA)

Light blue highlight = CCL 4 analyte with a completed method

July 2019 **Adapted from EPA graphic** Slide 53 of 278

UCMR5

PFAS

Contaminated Groundwater

Reduction Goal

CERCLA Designation

Designation On Hold

PFAS Numbers

PFBS & GenX

Research Funds

NDAA Concerns

NDAA Provisions

Military

Incineration

DoD Actions

TSCA Action

TRI Inclusion

The rule proposals also include groundwater cleanup criteria for contaminated groundwater that is a current or potential source of drinking water. This criterion applies when there are no state MCLs or other applicable or relevant requirements available or sufficiently protective. EPA published recommended levels for PFOA and PFOS in December 2019, with a combined limit of 70 **p**arts **p**er **t**rillion (ppt) as a "**p**reliminary **r**emediation **g**oal" (PRG) and 40 ppt as a recommended screening limit.[16] PRGs are generally initial targets for cleanup, and they may be adjusted on a site-specific basis as more information becomes available. Screening limits are risk-based values that are used to determine if levels of contamination may warrant further investigation at a site.

The next big ticket item is a hazardous substance designation. A hazardous substance designation under the Comprehensive Environmental Response, Compensation and Liability Act (CERLCA) would trigger reporting requirements for releases of these contaminants into air, water, or land. Under CERCLA, EPA has clear authority to initiate appropriate site investigations and potential cleanup efforts, as well as access to funding. When a substance is classified as a pollutant it must be shown to pose an "imminent and substantial danger to the public health or welfare" before the site can be investigated and cleaned up.[17] Without this designation under CERLCA the Department of Defense (DoD) can claim that "[T]he federal government is immune under 42 USC § 9620(a)(4) from a state enforcing its laws for the release of anything other than CERCLA hazardous substances."[18]

After the PFAS Summit held in May of 2018 we were all but assured we would see this classification implemented in short order. However, it now appears this determination will take much longer. In September of 2019, Bloomberg Environment reported that when EPA Administrator Wheeler was asked about this, he indicated that more scientific study was needed to understand how to clean up different PFAS compounds. He stated that we certainly do not have adequate scientific data to declare all PFAS hazardous, which was an original provision of the National Defense Authorization Act (NDAA). The NDAA would have given EPA one year to make this designation — thereby bypassing EPA's existing rules for determining what is hazardous. Administrator Wheeler pointed out that it would designate thousands of chemicals as hazardous without scientific data and lump in newer PFAS chemicals that previous administrations reviewed and found to not pose an unreasonable risk. The Administrator went on to say that EPA estimates there are 602 PFAS in commerce, and another 1,200 have been in commerce historically even though OECD has catalogued over 4,700 PFAS in existence.[19]

EPA agreed to release additional health advisory limits as data becomes available. In November 2018, EPA released a draft toxicological report for PFBS (perfluorobutanesulfonic acid) and GenX for public comment. The report remains in draft form as of April 2020. Around the same timeframe we saw European Union (EU) member states propose the addition of PFBS to their REACH candidate list. REACH is the Registration, Evaluation, Authorization, and Restriction of Chemicals regulation for European countries.[20]

Lastly, EPA has funded a multitude of research efforts — everything from trying to understand the potential impacts of PFAS on water quality and agricultural operations in rural communities, to understanding the characteristics and impacts of PFAS in waste streams. For these two efforts alone, there were $10.8M in research grants funded in 2019, but those efforts have just begun.

National Defense Authorization Act

There has been a lot of coverage of the National Defense Authorization Act (NDAA), which was signed into law at the end of 2019. The ongoing NDAA debate is all about what "made it in" and what was "left out." According to many critics the final bill fell short by not retaining provisions that would lead to the cleanup of PFAS chemicals across the country and mandate that the EPA establish drinking water standards.

The following are provisions *included* in the final bill:

- The US military will be prohibited from using AFFF containing PFAS chemicals after October 2024, with a few exceptions: use on ships, in emergency responses, and in limited testing and training circumstances.
- All incineration of AFFF must be conducted at a temperature range adequate to break down PFAS, while ensuring the maximum degree of reduction in emissions and all incineration must be conducted in accordance with the Clean Air Act and at a permitted facility. That is, a facility that has been permitted to receive waste regulated under the Solid Waste Disposal Act.
- Upon the request of a State Governor the DoD will be required to "work expeditiously" on agreements to address, test, monitor, remove, and remediate PFAS contamination in drinking water, surface water, or groundwater emanating from DoD activities.
- EPA is required to take final action on the agency's January 2015 proposal to amend a significant new use rule for long-chain PFAS chemicals under TSCA (Toxic Substances Control Act).
- Effective January 1, 2020 PFAS chemicals are deemed included in the Toxics Release Inventory (TRI) with a reporting threshold of 100 pounds per year.
- EPA's Administrator shall include PFAS chemicals in the fifth publication of the list of unregulated

PFAS
USGS Sampling

contaminants (UCMR5) to be monitored under the Safe Drinking Water Act.

- The Director of the United States Geological Survey (USGS) shall carry out a nationwide sampling to determine the concentration of highly fluorinated compounds in estuaries, lakes, streams, springs, wells, wetlands, rivers, aquifers, and soil.

Most of the PFAS provisions that were left out of the NDAA can be found in the PFAS Action Act 2019, which passed the US House on Jan 10th, 2020.[21]

Excluded Provisions

The following are key provisions whose *exclusion* from the final bill has drawn the most criticism:

- The Protect Drinking Water from PFAS Act (S. 1473), which would have required the EPA to promulgate an MCL for PFOA and PFOS within two years;
- The PFAS Action Act (H.R. 535, S. 638), which would have required EPA to designate PFAS chemicals as hazardous substances under CERCLA within one year; and
- The Clean Water Standards for PFAS Act (H.R. 3616), which would have required EPA to list PFAS chemicals as toxic pollutants, establish water pollution control standards, and promulgate pretreatment standards.

Toxics Release Inventory

Chemical Release Reports

Under the Emergency Planning and Community Right-to-Know Act, there is a Toxics Release Inventory (TRI) provision. This provision allows for the tracking of certain toxic chemicals that may pose a threat to human health and the environment. US facilities across industry sectors must report annually how much of each chemical is released to the environment. A "release" of a chemical means that it is emitted to the air, water, land, or placed in some type of land disposal.

160 PFAS Added

The NDAA for Fiscal Year 2020 added 160 PFAS to the list of chemicals covered by the TRI. These PFAS additions were effective as of January 1, 2020. As established by the NDAA, these 160 PFAS are reportable for the 2020 reporting year, with reporting forms due July 1, 2021. EPA published an updated list of 172 PFAS in February, 2020. The NDAA established a manufacture, processing, and otherwise use reporting threshold of 100 pounds for each of the listed PFAS. The law provides a framework for PFAS to be added automatically to the TRI list following certain EPA actions. For example, any PFAS compound for which the EPA finalizes a toxicity value would automatically be added to the TRI. The names and CAS (Chemical Abstract Service) numbers for some of the chemicals listed are subject to a claim of protection from disclosure, so EPA must review any such chemicals before they are added to the TRI list.[22]

State Actions

Drinking Water Surveys

In the absence of federal regulation have we seen continued developments at the state level. This is particularly true with regards to drinking water, both in terms of setting limits as well as conducting statewide surveys. At the turn of the calendar year states published a number of newly proposed drinking water limits. All these limits were MCLs or action limits as opposed to screening values. With the state of Michigan leading the way with a limit at 8 ppt for PFOA, there is a downward trend with setting limits in the single digit part per trillion range. Recently, New York, New Jersey, and Massachusetts have each proposed regulatory limits in the 10-20 ppt range for PFOA and PFOS.[23] Several states have conducted statewide surveys of public water systems. Some have been more comprehensive than others, as these efforts are largely dependent upon funding sources.

State Limits

Michigan Study

Michigan conducted the first, most comprehensive study of this type. Although Michigan appears to have more contaminated sites than most other states, the number of sites identified with some level of contamination is of course relative to the amount of testing done. The contamination levels Michigan discovered do not appear to have a significant impact on drinking water when compared to EPA's Health Advisory Limit (HAL). All but two sites in the statewide survey were non-detect above HAL levels of 70 ppt for PFOA and PFOS.[24] Pennsylvania found similar results, with only one out of 96 sites exceeding HAL.[25] In a tiered approach, California selectively looked at potentially impacted drinking water near commercial airports and landfills. Of the 570 wells tested, only 4% exceeded the HAL. However, California does have a notification level of 6.5 ppt and 5.1 ppt for PFOS and PFOA respectively. As compared to these values, 65% of the wells were below the notification levels.[26] This is why the toxicology is so important. As new science emerges, the limits deemed protective of human health or the most sensitive receptors continue to change.

California Notification Level

Other states — including Arizona, Kansas, Colorado, and Utah — have conducted drinking water assessments on a smaller scale or are in the process of expanding those efforts this year.

Target Analyte Lists and Method Criteria

Wisconsin Target List

Wisconsin is leading the way with the most comprehensive target analyte list for any of the states, established in 2019 for 36 compounds. Michigan has chosen to follow EPA, adopting the same 28 compounds referenced in the EPA method development efforts discussed below.

California has limited the required list of analytes to those commonly supported by the majority of laboratories supporting testing in the state. This equated to a target list of 25 compounds. However, the state did include an additional 13 compounds as optional.

PFAS Standards Lack

State-to-State Variability

These examples illustrate the increasingly varied approaches being implemented across the US. With the lack of standard methods for non-potable water and solid matrices, the states have begun establishing their own set of analytical protocols or criteria and setting their own regulatory limits.

Some states, like Michigan, started out with a much softer approach by recommending the use of laboratories with National Environmental Laboratory Accreditation Council (NELAC) or DoD accreditation. These laboratories were free to follow their own Standard Operating Procedures (SOP). California took it a step further by requiring compliance with the DoD Quality Systems Manual. We also have states developing their own unique method criteria. In Minnesota they refer to these as analytical requirements. In Wisconsin they have established performance-based criteria similar to the DoD approach. In New Jersey and Pennsylvania they have developed criteria which are largely based on the drinking water method but with the allowance of a quantitation scheme called "isotope dilution." The unfortunate part about these activities is none of this leads to improved consistency or reduced variability across state lines.

Analytical & Sampling Methods

New Methods

Analytical Methods continue to be an area fueling a lot of confusion for practitioners and regulators and where there is constant change. Much like last year was kicked off with an update to the EPA method for PFAS in drinking water — Method 537.1 — we started off 2020 with the addition of a new drinking water method, Method 533. This method was specifically generated to target the short chain PFAS compounds in preparation of adding these compounds to the UCMR5. **Figure 4** — a "Key Feature Comparison" — shows the differences between the two drinking water methods, sans the inclusion of a requirement to quantify branched and linear isomers, which appears in both methods. It is expected that both methods will be used in concert in order to capture the full range of PFAS compounds for which EPA has established protocols.

Non-Potable Water

Where the real confusion lies is in the analytical approach for measuring PFAS in any matrix other than potable water. There are no EPA published methods for non-potable water or solid matrices. ASTM International (formerly American Society for Testing & Materials) published two methods for PFAS in non-potable and solid matrices in recent years but neither were multi-lab validated and were not widely adopted by the commercial lab community. EPA drafted a new SW-846 method, 8327, which is based on ASTM Method 7979. EPA 8327 was released in the summer of 2019 for public comment (the comment period has since closed). As of March 2020, EPA indicated they are still in the process of responding to the public comments received and making appropriate adjustments to the method, so we await the final method to be published in the SW-846 Compendium.[27] This method received a number of criticisms through the public comment process, most notably from the Department of Defense, indicating this method falls short of the data quality objectives established by the DoD Quality Systems Manual.

Methods in Flux

Currently the ISO 25101 method for non-potable water matrices is only recognized by the State of New York. We have not seen other states adopt this method as it is not considered to be prescriptive enough and it only addresses PFOA and PFOS. Then we have the somewhat controversial 537 "Modified" method ("Modified" being somewhat of a misnomer because strict drinking water methods do not lend themselves to modifications). This is a laboratory-specific, user-defined method, based on the 537 methodology but adapted to support other matrices. The industry adopted this unconventional nomenclature under the unusual circumstances where there was no EPA source method to reference yet emerging regulations and demand for testing was increasing.

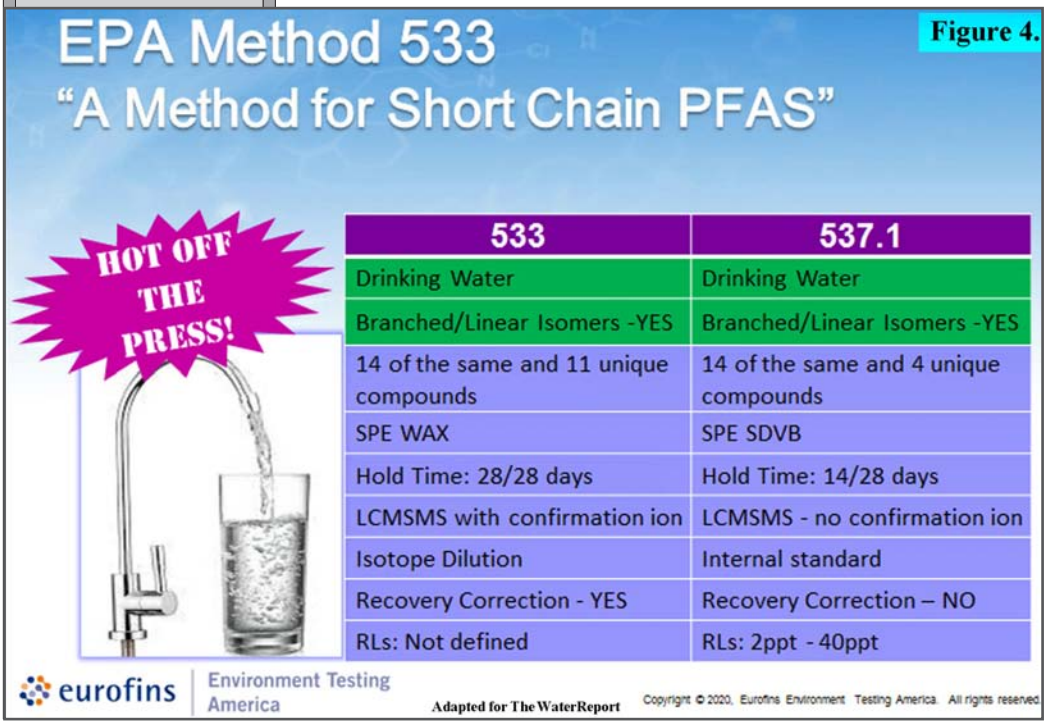


Figure 4.

Next up, EPA begins the process of generating a method in coordination with the DoD which will support the data quality objectives for the DoD. This method is expected to adopt many of the techniques the commercial laboratory industry has incorporated into their user-defined methods. This method is being developed by EPA's Office of Water and is expected to be published as a 1600 series method. EPA refers to this

PFAS

DoD Criteria

future method as the "SPE-ID" method, signifying that it will be a **s**olid **p**hase **e**xtraction (SPE) method using **i**sotope **d**ilution (ID) quantitation. According to EPA's latest Technical Brief (January 2020), the estimated timeframe for releasing this method is no sooner than 2021.[28]

Given the absence of a published EPA method for non-potable water and solid matrices many practitioners and some state agencies have adopted the DoD QSM criteria to ensure they are obtaining defensible and consistent data. Over the course of 2019, the Department of Defense revised their Quality Systems Manual from version 5.1, to 5.2 and finally 5.3 — where we saw additional revisions to Table B-15, which addresses PFAS in non-potable and solid matrices. Following these updates may be relevant to those supporting PFAS assessments outside of federal DoD programs, depending on which state the site is in or their ability to validate how the PFAS data are being generated.

Evolving Methods & Targets

Target Analyte Lists

As part of EPA's method development efforts, the target analyte list continues to grow and change as well. For the past few years, as EPA was working to validate method 8327, the target analyte list was 24 compounds. According to the same Technical Brief from January 2020, EPA indicated their intention to include the primary replacement chemicals that were added to method 537.1 to the previous list of 24 compounds. Now we are up to 28 target analytes. Given that EPA has recently published a second drinking water method with even more discrete analytes, it is reasonable to expect we may see the target list for non-potable water and solid matrices evolve even further.

Many PFAS Few Manuals

Emerging Analytical Technologies

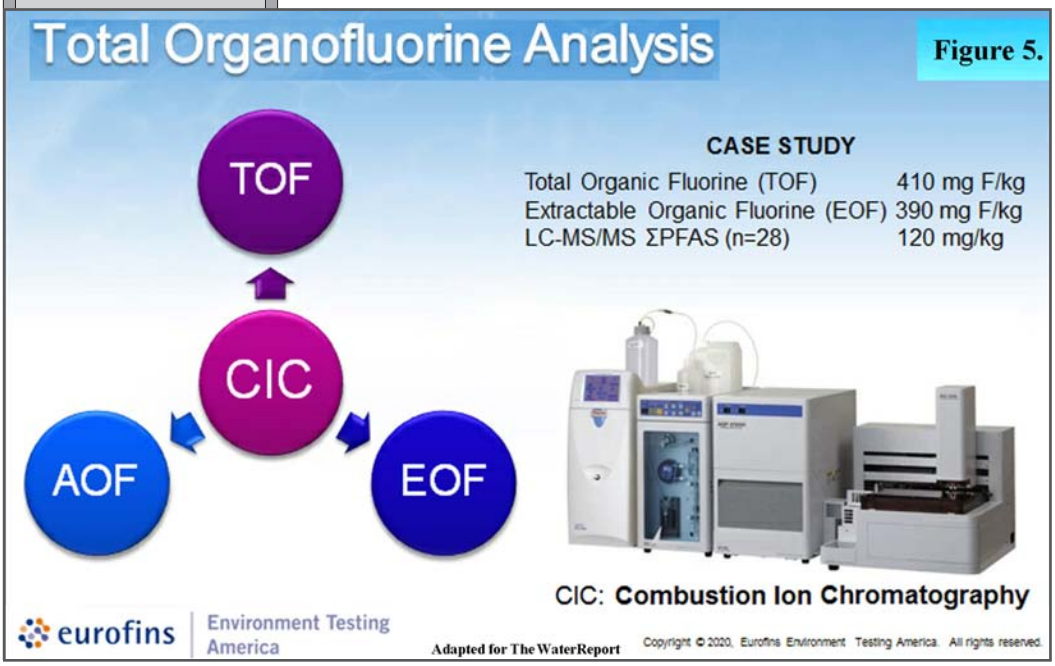
While standard methods are available for the analysis of a few dozen PFAS compounds, the quantitative analysis of other PFAS is difficult due to the sheer quantity of compounds and the lack of reference materials. Because of this, the full extent and distribution of PFAS precursors in the environment, and their eventual dead-end daughter products, have generally not been assessed. [Editor's note: "dead-end daughter product" refers to a chemical breakdown product (daughter) which will not breakdown any further (dead-end).] There are techniques available for capturing a total PFAS number as opposed to individual results for 4,000+ chemicals.

Total Fluorine Measurement

We do have a largely academic technique, the Particle-Induced Gamma-ray Emission test (PIGE). This measures total fluorine on consumer product or industrial product surfaces. It can also be used to measure total fluorine in water with possible detection limits of 1 **p**art **p**er **b**illion (ppb). Often times when journal and news articles reference results for Total Fluorine from a PIGE analysis in the US these data stem from a single lab — Dr. Graham Peaslee's lab at the University of Notre Dame. Dr. Peaslee has conducted a tremendous amount of work in this arena. Generally speaking, however, you will not find this analysis in commercial laboratories as it requires the use of a particle accelerator.

Rapid Screening Tool

With that said, what is available in the commercial world? We have **c**ombustion **i**on **c**hromatography (CIC). This technique is amenable to commercial environmental laboratories and is capable of capturing Total Organofluorine with slightly better sensitivity than the PIGE analysis, resulting in reporting limits in the single digit or less ppb range. CIC is intended to be a rapid screening tool and would be most useful at a contaminated site with concentrations at or above the ppb range. Many AFFF impacted sites would fall into this category. There are three options here; a Total result (TOF), an Adsorbable amount (AOF), or an Extractable Organofluorine (EOF) number (***see* Figure 5**). You can see that in Figure 5's case study the TOF and EOF results are within experimental measurement uncertainty but demonstrate a large difference between the conventional targeted LC-MS/MS analysis, meaning that there are considerable amounts of unknown PFAS in this example. These unknown PFAS are most likely precursor compounds which have the potential to transform in the environment into shorter chain perfluorinated chemicals. These precursors make up many of the unknown chemicals in this class of over 4,000 PFAS.



PFAS

"Non-Target Analysis"

With the PFAS class of chemicals we are operating in a world of mostly unknowns. With that, the ability to test for unknowns — otherwise know as "non-targeted analysis" — has become very attractive. Non-target analysis has promise across a wide range of PFAS-related applications, ranging from discovery of additional analytes of interest, to elucidation of environmental transformation pathways, to unique characterization of product formulations. This analysis is not limited by available reference material in the way that the standard EPA methods for PFAS analysis are. Multiple academic institutions and EPA's Office of Research and Development have made notable advancements in terms of discovery of next generation PFAS chemicals and characterization of product formulations. It is challenging to obtain government and academic resources to support commercial work, so in response commercial laboratories are developing these methods directly to support the industry as a whole.

Complex Matrices & Risk

A Look at Specific Matrices

Often times when we speak about PFAS in the environment or we look at environmental regulations, we see matrices like surface water, groundwater, and soils addressed. What we see less of are regulations and guidance that address the complexities of matrices like biosolids, landfill leachate, or source air. The following are complex matrices that have become increasingly important from a risk perspective.

Life Cycle End

Landfill Leachate

The end of life cycle for the PFAS chemicals widely used in industrial and consumer products is often at a landfill. Landfill leachate garnered growing attention in 2018 as some states worked to understand this life cycle and identify potential sources. This is a complex matrix which presents unique challenges. We have states like Michigan with a surface water limit of 11 ppt for PFOS — i.e., a limit well below the health advisory level for drinking water. It is very challenging to achieve trace level detection limits applicable to pristine drinking water in a concentrated material such as landfill leachate. Concentrations can vary widely depending on what was disposed of at the landfill. Various studies of landfills have concluded that they are predominantly made up of short chain PFAS, like PFBA and PFBS, rather than the longer chains. In an interesting study by Busch et al, they note that landfill leachate can represent less than 1% of mass flow from a wastewater treatment plant so it can be a minor source of PFAS into the aqueous environment.[29]

Varying Concentrations

Short Chain Compounds

Biosolids

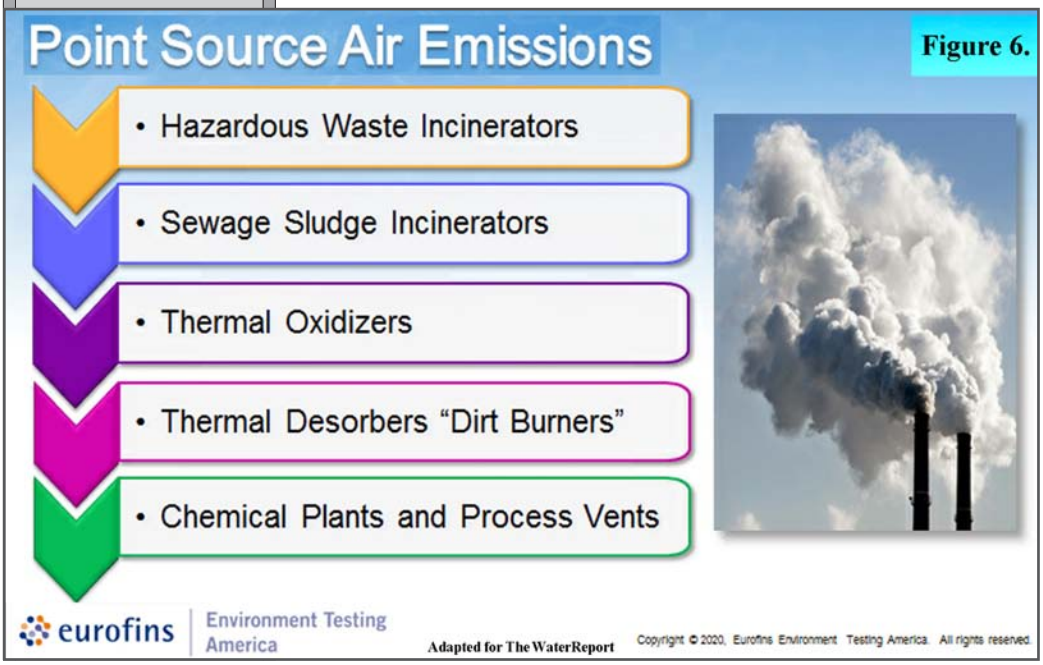
Biosolids are another related matrix that garnered increased attention in 2019. Probably most notable was Maine's response to a contaminated dairy farm from the land application of contaminated biosolids and this is when we saw the first state set a limit for PFAS in biosolids.[30] Biphasic samples and specifically samples with high particulates are a challenge. A determination must be made as to whether the data is needed to represent the PFAS concentration in the whole sample or only in the dissolved phase.

Diary Farm Response

Air

Air Emissions

A particularly hot topic these days is source air emissions (***see* Figure 6**). These are the processes currently receiving focused attention from state and federal regulators. Facilities emitting to air play a critical role in the beginning and end of life cycle for PFAS. The cycle begins with the manufacturing plants and then we have the treatment facilities like thermal oxidizers and incinerators at the end of the life cycle. So why is this a problem? We have source air emissions traveling via short and long range transport, contaminating ambient air with measurable impacts to surface water, soil, and eventually groundwater. And remember what made the final cut in this year's Defense Authorization Act. All incineration of AFFF must be conducted at a temperature range adequate to break down PFAS, while ensuring the maximum degree of reduction in emissions and all incineration must be conducted in accordance with the Clean Air Act at a permitted facility that has been permitted to receive waste regulated under the Solid Waste Disposal Act. This is one reason why we need a defensible method for characterizing PFAS from source air emissions.



PFAS

Ambient Air Concerns

PFAS in ambient air is also gaining more recognition.. We have limited data sets for what is present in the background in ambient air. There are no published methods for PFAS in source or ambient air. We begin again with methods that are built from EPA standard methods for semivolatile and volatile compounds in air, but modified to support PFAS complexities. The method development process has illuminated much about the unique chemical characteristics of these compounds and how they behave under different conditions, but we still have much to learn about what is present in the environment.

Consumer Products

We cannot talk about PFAS updates without mentioning consumer products. Over the course of 2019 we saw increased scrutiny of consumer and industrial use products.

Food Packaging

The Food and Drug Administration (FDA) has an approved list of PFAS chemicals for food packaging products, so this means our food does continue to come in contact with certain approved PFAS chemicals. Some researchers appear to be working to determine if only those chemicals are present. An example of this was reported in The Counter last fall about PFAS detections in food packaging materials from a few popular restaurant chains in New York City.[31]

Dairy Farm Contamination

There were also a few sites in the US that have resulted in an increased awareness about PFAS in the food supply, most notably cow's milk contaminated from nearby military installations at two different dairy farms. The FDA tested milk from the two farms of concern. They concluded that there was no indication the levels of PFAS found in the limited sampling of milk from one of the farms was a concern, but the other farm was determined to be a potential human health concern and all milk from that farm was discarded and did not enter the food supply.[32]

Total Diet Study

You may have also heard that chocolate cake would do you in. Fear not, in December 2019 the FDA posted results from the second round of testing for 16 PFAS in foods collected for the Total Diet Study (TDS) and chocolate cake was cleared of any harmful effects. TDS foods represent a broad range of foods, including breads, cakes, fruits, dairy, vegetables, meats, and bottled water, that the average consumer might eat and that were not specifically collected from areas of known environmental PFAS contamination. Out of 88 foods, only one sample, Tilapia, had even a detectable level of PFOS. The FDA has no indication that PFAS levels found in the limited sampling from these TDS present a human health concern. The FDA safety assessment method used for chemical contaminants considers how much people eat of the specific food and the toxicity of the specific contaminant. The FDA uses the EPA's reference doses for PFOA and PFOS — i.e., 0.02 micrograms per kilogram – by weight per day (µg/kg-bw/day) — as an appropriate toxicity reference value.[33]

Locals Bans

We are also seeing varying actions being taken by corporations, states and even city officials. The City of San Francisco banned PFAS in food packaging materials, effective Jan 1, 2020. The State of Washington's food paper packaging ban goes into effect January 2022, provided that safer alternatives have been identified. Several other states including California, New York, and Rhode Island are following their lead by introducing similar policies. Home Depot and Lowes banned the sale of any carpeting material with PFAS effective January 1, 2020. New York State approved a ban on PFAS containing firefighting foams over the next two years, unless suitable alternatives are not available by then.

Clearly, we see a lot of regulatory desire to remove these chemicals from the consumer product supply chain. However, given their uniquely powerful and useful qualities, these efforts are largely dependent upon finding safer and suitable alternatives.

Conclusion

Federal Guidance

The federal government appears to be gaining traction on a number of PFAS initiatives, but establishing formal guidance in the face of rapidly evolving science and promulgating laws takes time. In the meantime, here are some closing thoughts about how things may progress across the states.

In the early years New York and Michigan were two of the first states to address PFAS on a broad scale. Looking back at how PFAS investigations and regulation evolved in those states we see the emergence of similar approaches — i.e., a distinguishable "playbook" or a "roadmap" to rein-in PFAS impacts. Similar paths did play out in a number of states in 2019, including Maine, Connecticut, Wisconsin, Colorado, and California.

States' Playbook

Currently, the emerging playbook looks something like this:

- Initiating a PFAS Taskforce that works to develop a PFAS Action Plan
- Conducting foam surveys to identify sources and minimize future use
- Conducting drinking water surveys to identify current risk to receptors and potential hot spots
- Conducting wastewater surveys to identify sources and implement source reduction efforts
- For now, Airports, Landfills, Fire Training Areas, and Chrome Platers tend to be at the top of the priority list for assessments
- Some states have the ability to set their own MCLs and so their efforts may be targeted at pursuing this effort while other states do not have the authority to promulgate state specific MCLs, so they might be more focused on groundwater and surface water

PFAS

Needless to say, I would look for more of these types of efforts: "*Coming Soon to a State Near You*!"

For Additional Information:
Taryn McKnight, Eurofins Environment Testing America, 916/ 347-6815 or Taryn.McKnight@testamericainc.com

Taryn McKnight, PFAS Practice Leader for Eurofins Environment Testing America based in Sacramento, California, has nearly 20 years of experience in the environmental testing industry specializing in PFAS and Vapor Intrusion assessments. She provides technical guidance to clients, agencies, and industry personnel across the country.

Footnotes

1) OECD. *Comprehensive Global Database of Per-and Polyfluoroalkyl Substances* (*PFASs*). 2018. Available at: www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ENV-JM-MONO(2018)7&doclanguage=en
2) Higgins C, Field J, Deeb R, Conder J. 2017. *FAQs Regarding PFASs Associated with AFFF use at US Military Sites*. Environmental Security Technology Certification Program. Available at: https://apps.dtic.mil/dtic/tr/fulltext/u2/1044126.pdf
3) Guo Z, Liu X, Krebs K.A, Roache N.F. 2009. *Perfluorocarboxylic Acid Content in 116 Articles of Commerce*. US EPA. Available at: www.oecd.org/env/48125746.pdf
4) Sunderland EM, Hu XC, Dassuncao C, Tokranov AK, Wagner CC, Allen JG. *A Review of the Pathways of Human Exposure to Poly- and Perfluoroalkyl Substances* (*PFASs*) *and Present Understanding of Health Effects*. J Expo Sci Environ Epidemiol. 2019;29(2):131–147. doi:10.1038/s41370-018-0094-1
5) NIH. *Perfluoroalkyl and Polyfluoroalkyl Substances* (*PFAS*). Last Reviewed: April 15, 2020. Available at: www.niehs.nih.gov/health/topics/agents/pfc/index.cfm
6) EPA. *Risk Management for Per- and Polyfluoroalkyl Substances* (*PFAS*) *under TSCA*. Last Updated: February 20, 2020. Available at: www.epa.gov/assessing-and-managing-chemicals-under-tsca/risk-management-and-polyfluoroalkyl-substances-pfas#tab-3
7) Pelch K.E, Reade A, Wolffe T.A.M, Kwiatkowski C.F. 2019. *PFAS Health Effects Database: Protocol for a Systematic Evidence Map. Environment* International, 130, art. no. 104851
8) EPA. *GenX and PFBS Draft Toxicity Assessments*. Last Updated: April 1, 2020. Available at: www.epa.gov/pfas/genx-and-pfbs-draft-toxicity-assessments
9) EPA. *Drinking Water Health Advisory for Perfluorooctanoic Acid* (*PFOA*). May 2016. Available at: www.epa.gov/sites/production/files/2016-05/documents/pfoa_health_advisory_final_508.pdf
10) EPA. *Drinking Water Health Advisory for Perfluorooctane Sulfonate* (*PFOS*). May 2016. Available at: www.epa.gov/sites/production/files/2016-05/documents/pfos_health_advisory_final_508.pdf
11) EPA. *EPA's Per- and Polyfluoroalkyl Substances (PFAS) Action Plan*. February 2019. Available at: www.epa.gov/sites/production/files/2019-02/documents/pfas_action_plan_021319_508compliant_1.pdf
12) EPA. *Third Unregulated Contaminant Monitoring Rule*. May 2, 2012. Available at: www.epa.gov/dwucmr/third-unregulated-contaminant-monitoring-rule
13) EPA. *EPA Announces Proposed Decision to Regulate PFOA and PFOS in Drinking Water*. February 20, 2020. Available at: www.epa.gov/newsreleases/epa-announces-proposed-decision-regulate-pfoa-and-pfos-drinking-water
14) EPA. *Development of the Fifth Proposed Unregulated Contaminant Monitoring Rule (UCMR 5) for Public Water Systems Meeting Presentations*. Last Updated: October 10, 2019. Available at: www.epa.gov/dwucmr/development-fifth-proposed-unregulated-contaminant-monitoring-rule-ucmr-5-public-water
15) S. 1790 — 116th Congress: *National Defense Authorization Act for Fiscal Year 2020*. www.GovTrack.us. 2019. Available at: www.govtrack.us/congress/bills/116/s1790
16) EPA. *Interim Recommendations for Addressing Groundwater Contaminated with PFOA and PFOS*. December 2019. Available at: www.epa.gov/pfas/interim-recommendations-addressing-groundwater-contaminated-pfoa-and-pfos
17) Federal Register Volume 39, Issue 164 (August 22, 1974). Available at: www.govinfo.gov/
18) Melanie Benesh, *It's Time To Designate PFAS a* "*Hazardous Substance*", EWG, July 3, 2019. www.ewg.org/news-and-analysis/2019/07/it-s-time-designate-pfas-hazardous-substance
19) Pat Rizzuto, *PFAS Legislative Timelines Not Feasible, EPA's Wheeler Says*, Bloomberg Environment, September 26, 2019. https://news.bloombergenvironment.com/environment-and-energy/pfas-cleanup-timeline-not-feasible-epas-wheeler-says
20) Echa. Perfluorobutane sulfonic acid (PFBS) and its salts. January, 2020
21) S. 1790 — 116th Congress: *National Defense Authorization Act for Fiscal Year 2020*. www.GovTrack.us. 2019. Available at: www.govtrack.us/congress/bills/116/s1790
22) EPA. *List of PFAS Added to the TRI by the NDAA*. February 19, 2020. Available at: www.epa.gov/toxics-release-inventory-tri-program/list-pfas-added-tri-ndaa
23) ITRC. *PFAS Fact Sheet - Regulations, Guidance, and Advisories*. 2017. Available at: https://pfas-1.itrcweb.org/fact-sheets/
24) EGLE. *2018 Statewide Public Water Supply PFAS Testing Summary*. April, 2019. Available at: www.michigan.gov/pfasresponse/0,9038,7-365--495899--,00.html
25) Governor Tom Wolf. *Wolf Administration Continues to Address PFAS Contamination, Announces First Round of Statewide Sampling Results*. December 05, 2019. Available at: www.governor.pa.gov/newsroom/wolf-administration-continues-to-address-pfas-contamination-announces-first-round-of-statewide-sampling-results/
26) Bruderer L, Goldberg S, Veasy P. *PFAS Are Here: First Round of Results Show PFAS in California Drinking Water Supply Wells*. JD Supra. October 24, 2019. Available at: www.jdsupra.com/legalnews/pfas-are-here-first-round-of-results-77858/
27) EPA. *PFAS Action Plan: Program Update February 2020* (PDF). February, 2020. Available at: www.epa.gov/sites/production/files/2020-01/documents/pfas_action_plan_feb2020.pdf
28) EPA. *PFAS Methods and Guidance for Sampling and Analyzing Water and Other Environmental Media* (Technical Brief). January, 2020. Available at: www.epa.gov/water-research/pfas-methods-and-guidance-sampling-and-analyzing-water-and-other-environmental-media
29) Busch J, Ahrens L, Sturm R, Ebinghaus R. Polyfluoroalkyl *Compounds in Landfill Leachates*. Environmental Pollution Volume 158, Issue 5, May 2010, Pages 1467-1471
30) Maine Department of Environmental Protection. Memorandum: *Requirement to Analyze for PFAS Compounds*. March 22, 2019. Available at: www1.maine.gov/dep/spills/topics/pfas/03222019_Sludge_Memorandum.pdf
31) Joe Fassler, *The Bowls at Chipotle and Sweetgreen are Supposed to be Compostable. They Contain Cancer-Linked* "*Forever Chemicals*", The Counter, August 5, 2019. https://thecounter.org/pfas-forever-chemicals-sweetgreen-chipotle-compostable-biodegradable-bowls/
32) FDA. *FDA Makes Available Results from Second Round of Testing for PFAS in Foods from the General Food Supply*. December 20, 2019. Available at: www.fda.gov/food/cfsan-constituent-updates/fda-makes-available-results-second-round-testing-pfas-foods-general-food-supply
33) *Id*.

Texas Groundwater

"Ownership in Place"

Oil & Gas Principles

"Rule of Capture"

Rule Limits

"Conservation Amendment"

Groundwater Regulation

Ownership Interest

Real Property

Ownership Limits

GDC Authority

TEXAS GROUNDWATER: FAIR SHARE

TEXAS GROUNDWATER LAW COMPARED TO OIL AND GAS LAW
APPLICABILITY OF FAIR SHARE AND CORRELATIVE RIGHTS

by Shauna Fitzsimmons Sledge, Sledge Law Firm (Austin, TX)

Introduction

In recent years, Texas courts have applied oil and gas law to groundwater in the context of ownership and relationships between severed estates. Most notably, the Texas Supreme Court in 2012 applied the common law rule of "ownership in place" — a legal doctrine historically applied in oil and gas law — to groundwater law. However, as is often misunderstood, the Court never stated that groundwater should be regulated like oil and gas. In fact, the Court clearly explained that the management and regulation of groundwater differs significantly from oil and gas due to numerous differences in the resources.

This article examines the evolution of groundwater law as compared to oil and gas law in Texas. It identifies areas in which Texas courts and the Texas Legislature have decided to extend, or deliberately declined to extend, oil and gas legal principles to groundwater. It also examines the often confusing web of concepts involved in the leading opinions on these issues. These intertwined concepts include: the rule of capture; ownership; relationships between severed states; correlative rights in a common resource; regulation of the common resource; and the right to a "fair share."

Evolution of Groundwater Law Compared to Oil and Gas Law in Texas

THE RULE OF CAPTURE, OWNERSHIP, & REGULATION

Prior to the existence of any statutes governing groundwater or oil and gas in Texas, the Texas Supreme Court (Court) adopted the English common law "rule of capture" as the law for groundwater in 1904.[1] Eleven years later, in 1915, the Court applied the rule of capture to oil and gas.[2]

Essentially, the rule of capture provides that, absent malice or willful waste, landowners have the right to take all the water (or oil and gas) they can capture under their land and do with it what they please. Landowners will not be liable to neighbors even if their own use deprives their neighbors of the water's (or oil and gas's) use.[3]

Today, this right to take and use water or oil and gas under the rule of capture is limited by both common law and conservation statutes and regulations. Due to significant litigation in oil and gas, the parameters of the rule of capture in the context of oil and gas became well established early on. By the mid-1900s, oil and gas law, including liability under the rule of capture, ownership, and regulation, was already well settled. In contrast, after 1904, and for the next 100 years, groundwater jurisprudence in Texas was sparse. However, in the few judicial opinions that were issued, Texas courts continued to uphold the rule of capture in terms of both allocating groundwater rights and liability between adjacent landowners.[4]

Following droughts in 1910 and 1917, the citizens of Texas voted to enact Article 16, Section 59 of the Texas Constitution (the "Conservation Amendment"), which granted and imposed on the Texas Legislature the authority and the duty to preserve the state's natural resources, including groundwater.[5] The Conservation Amendment gave the legislature the authority to modify the rights of landowners under the rule of capture through regulation of the resource. In response, the legislature declared local **g**roundwater **c**onservation **d**istricts (GCDs or "districts") the preferred method of groundwater management and regulation in Texas.[6] The legislature first exercised its constitutional authority to create GCDs in 1949.

The majority of GCDs that exist today were created after 1997 following the passage of Senate Bill 1. That bill revamped Chapter 36 of the Texas Water Code — the primary statutory authority governing GCDs — in an effort to improve and promote the regulation of groundwater through local GCDs.[7]

In addition to implementing its constitutional authority to manage and regulate groundwater — and in the absence of any case law further defining the nature of a landowner's ownership interest[8] — the Texas Legislature attempted to statutorily define that ownership interest. Texas Water Code Section 36.002, amended to address this issue by Senate Bill 332 in 2011[9], provides that a landowner owns the groundwater below the surface of the landowner's land as real property. This ownership entitles the landowner to drill for and produce the groundwater below the surface, subject to the common law limitations against waste and malicious drainage of other property or negligently causing subsidence.[10] The statute is clear that ownership, as defined by the legislature, does *not* entitle a landowner to a specific amount of groundwater or affect common law defenses or other defenses to liability under the rule of capture.[11]

Senate Bill 332 is also clear that ownership does not:

- prohibit a GCD from limiting or prohibiting the drilling of a well by a landowner for failure or inability to comply with minimum well spacing or tract size requirements adopted by the GCD;
- affect the ability of the GCD to regulate groundwater production as authorized by Chapter 36 of the Texas Water Code or a GCD's special enabling legislation; or
- require a GCD to allocate to a landowner a proportionate share of available groundwater based on acreage owned.[12]

As the demand for groundwater has increased, however, so have questions regarding the interplay between groundwater regulation, ownership, and the rule of capture.

Texas Groundwater

Groundwater Owned in Place

"Takings" Claim

Regulation Modifies Rule of Capture

Sever & Sell

Accommodation Doctrine

Regulation Differs

Oil & Gas Distinctions

Replenishment

Resource Use

Groundwater Values

Similarities: Ownership & Relationships Between Severed Estates

Beginning in 2008, Texas courts have applied legal principles well established in oil and gas to groundwater in the context of ownership and in resolving disputes between severed estates. To date, there are three cases in which courts have applied oil and gas law to groundwater law, the most notable being *Edwards Aquifer Authority v. Day*.[13]

On the heels of the legislature's 2011 effort to define the nature of the ownership interest in groundwater, the Court in *Day* held for the first time that groundwater, like oil and gas, is owned in place beneath the ground.[14] Like in oil and gas, under the common law rule of ownership in place, a landowner has a vested ownership interest to the groundwater in place beneath his property — which therefore may be the subject of a "takings" claim.[15] In reaching this decision, the Court in *Day* cited Texas Water Code Section 36.002 (amended in 2011), finding that the ownership language in the statute indicated that the legislature supported this view of the common law.[16]

The Court in *Day* further explained that, like in oil and gas, the only qualification of this rule of ownership in place is that it must be considered in connection with the rule of capture and is subject to regulation under the police power.[17] Under the rule of capture there is no liability for reasonable and legitimate drainage from the common pool. Absent regulation, the only remedy for drainage under the rule of capture is self-help through exploitation of the underlying resources. Thus, in reconciling the three fundamental tenets of the law — regulation, the rule of capture, and ownership — regulation impliedly modifies the rule of capture.[18] Regulation does not affect the doctrine of ownership-in-place or the right of capture with respect to liability between adjoining landowners.[19] Ownership in place means a landowner has a constitutionally compensable interest in the groundwater, and "while property may be regulated to a certain extent, if regulation goes too far it will be recognized as a taking… ."[20]

The other two cases to date in which Texas courts have applied oil and gas legal principles to groundwater involve relationships between severed estates. In *Del Rio v. Clayton Sam Colt Hamilton Trust*, the court held that the groundwater estate, like in oil and gas, can be severed from the surface estate and sold as a real property right, rejecting arguments that it was not a vested right.[21] Most recently, in *Coyote Lake Ranch, LLC v. City of Lubbock*, the Court applied the accommodation doctrine from oil and gas law to groundwater law.[22] The accommodation doctrine addresses the relationship between a mineral estate owner and a surface estate owner regarding access to the land surface to recover minerals. The Court found that the accommodation doctrine had worked well in the oil and gas context and found no reason why the doctrine should not be applied to resolve conflicts in the relationship between the owner of a severed groundwater estate and the surface estate owner.[23]

As of the writing of this paper, these are the only three cases in which Texas courts have applied oil and gas law to groundwater.

Differences: Management & Regulation

The courts and other legal authority have clearly stated that oil and gas is differentiable from groundwater in the context of management and regulation due to the inherent differences in the two resources. Because of these differences, the Court in *Day* went out of its way to clarify that, while it saw no reason to depart from well-established principles of oil and gas law in defining the nature of the ownership interest in groundwater, the regulation of these separate resources differs substantially.

In examining the two resources, the Court above all else noted the renewable nature of groundwater as a substantial difference from oil and gas.[24] Unlike oil and gas, which cannot generally be replenished, groundwater can be replenished through recharge by rainfall, drainage, or other surface water.[25] Moreover, because of differences in hydrogeologic conditions in different types of aquifers (and even within the same aquifer) recharge may occur over a matter of days or it may take thousands of years to recharge that portion of an aquifer accessed by a well.[26] Thus, the amount of groundwater under the surface may increase or decrease depending on the recharge rate and the unique characteristics of the aquifer. The groundwater volume associated with the overlying surface may constantly be changing.[27]

Another substantial difference in comparing groundwater to oil and gas, noted by the Court in *Day*, is the use of the resource.[28] Generally, oil and gas is used solely as a commodity, sold once it is produced at the wellhead.[29] In contrast, while groundwater may also be sold as a commodity, its uses vary widely, from agriculture, to industry, to drinking, to recreation. Water uses often do not involve its sale.[30]

Unlike oil and gas, there is value in leaving the groundwater in-place underground or preserving groundwater for future use.[31] Groundwater left underground provides value to property owners and the environment by: supporting spring flow; keeping rivers flowing between rainfall events through baseflow (flow from aquifers to rivers); preventing land-surface subsidence; and supplying water for animals and vegetation.[32] Additionally, the availability of groundwater to the overlying surface estate often determines the value of the surface estate, and to the extent alternative water supplies are unavailable, the absence of groundwater as an economically viable water supply may diminish the value of the surface estate.[33]

Texas Groundwater

Differing Regulations

Railroad Commission v. GCDs

Commodity v. Renewable Resource

Waste Distinctions

"Correlative Rights"

Oil & Gas

Applicablity to Rule of Capture

Oil & Gas "Fair Share"

These inherent differences in oil and gas versus groundwater have resulted in differences in how the resources are regulated and the goals associated with such regulation. Oil and gas is regulated by a single state agency, the Railroad Commission of Texas (Commission), with common jurisdiction over all oil and gas resources.[34] Groundwater in Texas is regulated by approximately 100 different local or regional GCDs and subsidence districts, with each district typically having only partial jurisdiction over one or more aquifers.[35] Pursuant to its authority under the Texas Natural Resources Code, the Commission has adopted statewide rules that apply to all oil and gas operations in Texas as well as local field rules that apply only to the operations within a field designated by the Commission. Pursuant to Chapter 36 of the Texas Water Code, districts have adopted rules to regulate and manage the groundwater resources within their respective jurisdictions, most of which generally coincide with the boundaries of one or more counties. Districts overlying the same aquifer are statutorily required to work together to engage in joint planning activities for the common aquifer, including setting desired future conditions for the aquifers.[36] Districts are further required to manage the groundwater resources within their boundaries to achieve such desired conditions.[37]

Because oil and gas are used solely as a commodities, the goal in regulating oil and gas is maximizing ultimate recovery of every last drop of the resource (i.e. prevent waste) while ensuring the mineral estate owners each receive adequate compensation for their fair share of the resource.[38] Because groundwater is a renewable resource with many beneficial uses — including being used entirely on the land from which it is produced — the goal in regulating groundwater is arguably to manage the long-term viability of the resource. Long-term viability protects property rights and balances the conservation and development of groundwater to meet the needs of Texans by using the best available science.[39] As noted by the Court in *Day*, there are many more factors that must be taken into account in the regulation of groundwater as compared to oil and gas.

Finally, while both groundwater and mineral estates are protected from waste under common law,[40] waste is also statutorily prohibited in both oil and gas law and groundwater law. However, the concept of waste and its legal definition in oil and gas law and groundwater law differs significantly. In oil and gas law, waste relates to drilling, spacing, or operating wells in a manner that reduces the total ultimate recovery of oil and gas from any pool.[41] In groundwater, waste relates to not preserving and conserving the resource. For water, waste includes: withdrawal that threatens or harms the quality of the resource; production that is not put to a beneficial purpose; any unnatural escape of the groundwater from the aquifer; or discharging groundwater to a surface stream or impoundment.[42]

Fair Share and Correlative Rights: A Creature of Regulation

Post *Day*, there has been much debate over the application of the fair share doctrine in groundwater. In Texas, the fair share doctrine is a legal principle historically applied to oil and gas. This doctrine is derived from the recognition of correlative rights.

It is important to distinguish how the term "correlative rights" has been commonly used in the vernacular in Texas water circles as opposed to how the courts use the term.[43] In groundwater circles throughout Texas, the term "correlative rights" has been commonly used to describe a type of regulatory approach that limits groundwater production based solely on acreage ownership. However, this is not what "correlative rights" means under the law, nor is it how correlative rights are necessarily recognized in the oil and gas industry.[44]

For oil and gas, "correlative rights" is merely a convenient method of indicating that each owner of land overlying a common source has legal privileges, relative to other owners of such land, to take oil or gas by lawful operations conducted on his own land. Each owner has duties to the other owners not to exercise his privileges of operation so as to injure the common source of supply; and each such owner has rights that other owners *not* exercise their privileges of operation so as to injure the common source of supply.[45]

This basic understanding of correlative rights is even applicable to the rule of capture absent regulation: "If the owners of adjacent lands have the right to appropriate, without liability, the gas and oil underlying their neighbor's land, then their neighbor has the correlative right to appropriate, through like methods of drainage, the gas and oil underlying the tracts adjacent to his own."[46] Accordingly, such owners' correlative right to appropriate must also be recognized when the resource is regulated to give owners the fair chance to produce the oil and gas beneath their property before their neighbor appropriates their oil and gas through drainage without liability under the rule of capture.[47]

For this reason, the Court has stated that correlative rights are a creature of regulation and not common law.[48] In oil and gas, regulations are designed to afford each owner a reasonable opportunity to produce his proportionate part of the oil and gas from the entire pool and to prevent operating practices injurious to the common reservoir. The idea is that if all operators exercise the same degree of skill and diligence, each owner will recover their fair share of the oil and gas in most instances.[49]

Texas Groundwater

Oil & Gas Rights

Maximized Recovery

Well Density

"Proration Unit"

Spacing Requirements

"Fair Share"

Allocation Formula

Opportunity to Produce

Owners' Rights & Duties

Common Law Limitations

Fair Share Applied in Oil and Gas Regulation

Texas courts have found that correlative rights of adjoining landowners over a common reservoir of oil or gas are recognized through state regulation by the Commission. The Texas Legislature has vested the Railroad Commission of Texas with jurisdiction over all oil and gas wells in Texas and the authority to adopt all necessary rules related to such wells.[50] The Commission has adopted statewide regulations and field rules[51] that control the location of wells and well production to protect correlative rights and afford each mineral owner the opportunity to produce their fair share of the recoverable oil and gas.

The Commission has adopted spacing requirements for the purpose of limiting the number of wells and locating the wells in particular positions to maximize recovery of a field.[52] The rules require minimum distances between new wells and existing wells and between new wells and property lines.[53] The statewide spacing rule adopted by the Commission, referred to as Statewide Rule 37, applies to all oil and gas wells in Texas to the extent it has not been preempted by specific field rules.

Similar to well spacing rules, the Commission has adopted well density rules for the purpose of establishing the acreage that wells in a specific field can drain efficiently.[54] The statewide well density rule adopted by the Commission, referred to as Statewide Rule 38, applies to all oil and gas wells in Texas to the extent it has not been preempted by specific field rules.[55] Well density rules require the assignment of a specified number of acres to a well after it has been drilled, creating a "proration unit."[56] A proration unit is the "acreage assigned to a well for the purpose of assigning [production] allowables and allocating allowable production to the well."[57] Generally, an operator must first designate a well's proration unit and the acreage assigned to it, then certify that the acreage is productive before receiving the well's production allowable.[58] Acreage assigned to a well "for allocation of allowables" may not be assigned to another well in the same field.[59] "Production allowables" refer to the maximum amount of hydrocarbons a well may recover as prescribed by the applicable field rules and "are designed to limit production from a well in order to control the rate of production from the field."[60]

While tracts of land are often pooled to form spacing or drilling units in conformity with Rule 37 and Rule 38, the Commission has adopted rules to allow for exceptions to its spacing requirements "to prevent waste or to prevent the confiscation of property."[61] Any one desiring to drill a well at a lesser distance must secure a special permit, after notice and hearing.[62] Such applicant assumes the burden of proof that such well is necessary to prevent waste or to prevent the confiscation of property.[63] The rule of fair chance or fair share is the reason for the confiscation exception to Rule 37, through which an owner or lessee can obtain a well permit for a small tract.[64] However, an owner is not entitled to a first well as a matter of right because the right to a well on a tract of land is not a vested right in the land itself, but is a right of the owner.[65] Thus, the proper test of confiscation under Rule 37 is whether an owner, with the wells that already exist, has been accorded a fair and equal opportunity (or fair chance) with other producers of surrounding tracts within the drainage area to recover his fair share of the oil in place beneath his tract.[66] If he has, no confiscation results.[67]

Field rules provide an "allocation formula" for wells in a field, which establishes how the allowable assigned to the entire field is distributed among the wells in the field. The factors used in such formulas include: the amount of acreage in a well's proration unit; the initial potential of the well; the initial pressure of the reservoir in the well; the deliverability of the well; or a combination of these factors. The most common factor considered in setting allowables in field rules is acreage assigned to a well in a well's proration unit.

Collectively, these rules and regulations are designed to prevent waste and recognize the correlative rights between the various landowners over a common reservoir of oil and gas in order to afford mineral owners the opportunity to produce their fair share of the common resource. Nonetheless, mineral owners are generally not entitled to, or limited to, produce any specific amount of the minerals based on the number of surface acres owned. In most cases, well spacing and density requirements serve as the more limiting restraint on the quantity of oil and gas produced than production allowables.

Fair Share Applied in Groundwater Regulation

Like in oil and gas, in groundwater the term correlative rights, in the most basic sense, indicates that each owner of land in a common source has:

- legal privileges as against other owners to take groundwater through lawful operations conducted on his own land;
- duties to the other owners in the common source *not* to exercise his privileges so as to injure the common source of supply; and
- rights that other owners *not* exercise their privileges so as to injure the common source of supply.[68]

In groundwater law, there are only two common law limitations to the rule of capture: 1) where water appropriation results in wonton or willful waste; or 2) where groundwater pumping negligently causes subsidence to the neighbor's adjacent property. Thus, without regulation, under the rule of capture ownership in place has no effect on the correlative rights of owners in a common source to appropriate, *without liability*, the groundwater underlying their neighbor's property.[69] As a consequence, regulation

Texas Groundwater

Day Decision

GW Regulation Purpose

GW Rights Different

Not Acreage-Based

Multiple Factors

"Takings" Liability

Groundwater Conservation Districts (GCDs)

Permitting Exemptions

GCD Regulation Considerations

Hydrology

Historic Use

Protecting Use

is necessary, according to the Court, and the Texas Legislature is responsible for the regulation of natural resources, including groundwater.[70] The Court was also clear that correlative rights are a creature of regulation, because without regulation the correlative rights of owners in a common source of supply are limited to those privileges and duties and defenses provided under the common law rule of capture and applicable common law limitations.[71]

In reaching its decision that the common law rule of ownership in place, as applied in oil and gas law, also applies to groundwater law, the Court in *Day* rejected the Edward Aquifer Authority's argument that groundwater must be treated differently from oil and gas because the law recognizes correlative rights in oil and gas but not in groundwater.[72] The Court explained that, similar to oil and gas, one purpose of groundwater regulation is to afford each landowner his or her "fair share" of the common resource.[73] However, due to the differences between oil and gas and groundwater,[74] the Court expressly stated, "regulation that affords an owner a fair share of subsurface water must take into account factors other than surface area."[75] Specifically, the Court explained that groundwater regulation must consider allowing landowners the ability to recover their reasonable investment-backed expectations.[76] "Groundwater regulation must take into account not only historic usage but future needs, including the relative importance of various uses, as well as concerns unrelated to use, such as environmental impacts and subsidence."[77] Thus, while correlative rights apply in both oil and gas and groundwater, correlative rights in groundwater are different than correlative rights in oil and gas.

Counter to popular misconception, the *Day* case does not mandate an acreage-based regulatory approach to be used by districts to afford each owner a "fair share" of groundwater and avoid takings claims. To the contrary, as noted above, the Court stated unequivocally that groundwater regulation that affords a landowner a "fair share" of the common resource must be based on multiple factors. Moreover, a careful review of the court's opinion in *Day*, along with the only appellate opinion to date that has found a compensable taking from groundwater regulation in Texas,[78]indicates that districts are likely more susceptible to takings liability if they do not protect landowners' reasonable investment-backed expectations through historic use regulations. With the exception of *Day*, the author is aware of no other case law in which Texas courts have attempted to define or further delineate a property owner's "right to a fair share" in groundwater.

The Texas Legislature has charged districts with the duty and authority to manage and protect the groundwater resources as well as protect the private property rights related to groundwater within their jurisdiction. This charge is pursuant to their statutory powers and duties as set forth in Chapter 36 of the Texas Water Code (Chapter 36) and their respective enabling legislation, if any.[79]

Chapter 36 directs districts:

- to adopt and enforce rules to regulate and manage the groundwater resources;[80]
- to adopt a permitting system "for the drilling, equipping, operating, or completing of wells or for substantially altering the size of wells or well pumps";[81] and
- to regulate well spacing and groundwater production.[82]

There are certain exceptions to the general rule that all water wells within a district must be permitted. While districts are statutorily authorized to exempt by rule any well from its permitting requirements, Chapter 36 mandates that districts exempt at least three specific classes of wells from all permitting requirements:

1) wells used solely for domestic use or for providing water for livestock or poultry on a tract of land larger than ten acres (so long as the well is incapable of producing more than 25,000 gallons of water per day);[83]
2) certain wells used solely to supply water to a rig that is actively engaged in drilling or exploration operations for an oil and gas well permitted by the Commission;[84] and
3) certain wells used for surface coal mining activities.[85]

When regulating groundwater production through the issuance of permits to non-exempt wells, a district may consider:

- setting well production limits;
- limiting water production based on acreage or tract size;
- limiting water production from a defined number of acres assigned to an authorized well site;
- limiting production on the basis of acre-feet per acre or gallons per minute per well per site; or
- managed depletion.[86]

Districts are required to select a method of regulating groundwater production that is appropriate based on the hydrological conditions of the aquifer or aquifers in the district.[87] Districts also have the permissive authority to preserve historic or existing use of groundwater that exists at the time a district adopts rules limiting groundwater production.[88] GCDs may impose more restrictive permit conditions on all permit applications by new users, and by applications to increase use by historic users, if such conditions bear a reasonable relationship to the district management plan and are reasonably necessary to protect existing use.[89] Additionally, in regulating groundwater production based on acreage or tract size, districts may consider the service needs or service area of a retail public water utility.[90]

Texas Groundwater

"Desired Future Conditions"

Ultimately, a district must adopt and enforce groundwater allocation and permitting regulations that are designed to achieve the management and planning goals established for the aquifers for which the district has management responsibility[91] — i.e. the **d**esired **f**uture **c**onditions (DFCs) for the aquifers. DFCs are developed and adopted on a regional basis in each groundwater management area in the state.[92] Districts are authorized to adopt different rules for different aquifers or for different geographic areas of an aquifer based on varying conditions in or use of the aquifers.[93]

Enabling Legislation

Districts must also develop rules consistent with their enabling legislation. Often, differences between districts' rules are a result of differences in their respective enabling legislation. Such differences may affect their funding, exemptions, or existing uses with investment-backed expectations. The combination of districts' individual enabling legislation and unique local conditions — such as hydrogeological variations and widely disparate patterns of groundwater use in different areas over the same aquifer — results in differing regulatory frameworks that districts utilize in accordance with the regulatory tools provided in Chapter 36.

Availability Issues

After *Day*, districts have struggled with how to allocate groundwater production in areas of limited groundwater availability. Demand frequently exceeds available supplies if DFCs are to be achieved. In many cases, the water demand by existing permitted users and exempt users alone exceeds the amount of groundwater available for production within a district. The inference from the Court's discussion and decision in *Day*, though, is that new users with an ownership interest in the groundwater also have a right to access some portion of available groundwater. Thus, districts grapple with threats of takings lawsuits from new users if their groundwater allocation and permitting regulations go too far to protect historic users, as well as threats from historic users if regulations impact their ability to recover reasonable investment-backed expectations.

The following regulations are the primary groundwater allocation methods used by districts to strike a balance between these competing demands. Often times, districts adopt a regulatory scheme that utilizes a hybrid approach incorporating two or more allocation methods.[94]

Allocation Methods

Surface Acreage Only: All groundwater production (including production by historic, existing, and future users/wells) is permitted based on the amount of surface acreage owned or leased over an aquifer. This is an approach predominately used in areas where agricultural irrigation is the primary use of local groundwater resources. It makes sense to allocate groundwater to a farmer based on how many acres of crop will be irrigated, so that the more land owned and irrigated above the aquifer, the greater the groundwater regulation. Similar to oil and gas, in most cases the acreage assigned to a well to support the amount of groundwater produced from the well must be contiguous to the well site.

Hybrid - Historic Use and Surface Acreage: Existing groundwater users/landowners with wells drilled *before* the adoption of rules by the district are permitted based on their maximum historic or existing use. New groundwater production (including from new wells and from existing wells in an amount or for a use that is not authorized under a historic or existing use permit) is permitted based on a specified amount of groundwater per surface acre owned or leased.

Spacing & Capacity

Well Spacing: Similar to oil and gas, districts have adopted well spacing rules that require new wells to be spaced a minimum distance from property lines and/or from existing wells completed in the same aquifer formation. The larger the capacity of the well, the larger the required spacing distances from property lines and from existing wells. The primary goal of such regulations is typically to confine the majority of the impacts from a well's production to the property where it is located. Like oil and gas, districts have adopted rules that allow certain exceptions to spacing requirements.

Reasonable (Non-Speculative)

Reasonable Use: All groundwater production is permitted based on beneficial use and reasonable, non-speculative demand (typically utilized in more urbanized areas). This approach usually requires a technical evaluation of the amount of groundwater applied for and the amount reasonably determined necessary to meet that demand (e.g. an applicant applies for a permit for a 1000-unit residential subdivision, and the groundwater authorized is limited to the amount reasonably needed by that many households). This demand analysis establishes the amount of groundwater realistically needed to support the applied-for use while also promoting conservation.

Hydrogeologic Conditions & Unreasonable Impacts

Permitting Wells Based on Site-Specific Conditions: Groundwater production is based on site-specific hydrogeologic conditions or site-specific testing for *unreasonable* impacts to the aquifer or existing wells. The approach works well in aquifers of wide heterogeneity. These types of rules typically apply to applications for larger wells. They require application of the best available science in a technical evaluation of hydrogeologic conditions and hydraulic properties of the aquifer in the immediate vicinity of the proposed well site as well as off-site impacts. Evaluation includes impacts to existing wells and/or desired future conditions. Rather than applying blanket assumptions and estimates of availability, this process allows for a permit based on the specific groundwater resources and conditions located underneath their property. The process also aims at protecting the property rights of existing and future users by managing conditions in the common pool.[95]

Texas Groundwater

Hybrid Approach

The balancing of competing demands for groundwater in a manner that affords all landowners a "fair share of the resource" is a complex undertaking. Due to the overriding concern of allowing recovery of reasonable investment-backed expectations, many districts have implemented a hybrid approach. This provides protections to historic users to recover their groundwater-related investments while allocating production of additional groundwater to new users based on surface acreage, reasonable use, well spacing, or site-specific hydrogeological analysis. It is clear that any attempt to impose a single regulatory approach for a "fair share" of the groundwater resources would be a wholly futile effort. Providing a "fair share" to all property owners over an aquifer is so inherently complex it requires hybrid systems of regulation.[96] A single approach would result in much more unfair treatment of landowners and a proliferation of takings litigation, as opposed to the current hybrid system of regulation which is tailored to local conditions and needs.

Recent Developments on Groundwater Allocation and Fair Share

Legislative Proposals

There have been recent proposals in the Texas Legislature to amend Chapter 36 to both define "fair share" on a statewide basis and to fundamentally alter the groundwater allocation and permitting tools that districts may use.[97]

Defining "Fair Share"

One proposal would have required districts to quantify the amount of groundwater in place beneath each tract of land that could be produced under the applicable "**d**esired **f**uture **c**onditions" (DFCs) and the operating and hydrogeological conditions of the area. The aim would be to show there would be no confiscation by uncompensated drainage of the fair share of groundwater in place under *other* tracts of land.[98] However, this attempt to define or quantify the specific amount of groundwater under each tract of land as the landowner's "fair share" is counter to how the fair share doctrine has been applied in oil and gas. In oil and gas law, fair share is not defined or quantified. Instead the legislature has granted the Commission broad authority to adopt rules governing the spacing, density, and allowables of wells, which in effect are meant to protect the correlative rights of owners by giving all owners the *fair chance to produce a fair share* of the minerals. The Court has stated that although a mineral owner has a right to its fair share of the minerals underlying its property, this right does not extend to specific oil and gas beneath the property.[99] The Court has further stated that a mineral is entitled, not to the molecules actually residing below the surface, but to a "fair chance to recover the oil and gas in or under his land, or the equivalents in kind."[100]

Quantification Intent

The proposed quantification of each landowner's amount of groundwater production was intended to protect private property rights. However, it was met with opposition from landowners whose authorized production is based on other statutorily authorized factors — including their historic groundwater use — which constitute their fair share of the resources.

Historic Use Factor

Unlike oil and gas, historic use plays an important role in the regulation of groundwater in Texas. Regulating groundwater production through the issuance of permits based on historic or existing use is authorized not only in Chapter 36, but also in districts' individual enabling legislation. Pursuant to this authority, the majority of districts in Texas have adopted rules and issued permits to landowners that have some type of grandfathering or historic use protections. Mandating a specific statewide approach to quantifying landowners' fair share of the groundwater would be in direct conflict with existing law and the rules promulgated by districts under the law. It would also have significant impacts on the private property rights of landowners who currently rely on such rules to produce their fair share of the groundwater. Additionally, as noted above, it would be virtually impossible to implement a one-size-fits-all legislative approach to permitting groundwater production that would work to afford a "fair share" to all landowners throughout the state, or even within the same aquifer.[101]

Quantification Issues

Intertwined Regulatory Tools

From a legal perspective, there are grave concerns regarding the continued attempts to entice the legislature to make changes to the permissive statutory groundwater allocation tools. There are severe implications to such changes. Any fundamental change in one of the intertwined statutory groundwater regulatory tools that are currently being utilized by districts — whether by deletion of a tool or by mandating that all districts utilize one particular tool — could be disastrous. The impact could injure Texas' economy. The investments of landowners, farmers, industry, businesses, public water suppliers, and others that have made substantial economic investments under existing GDCs' rules would be in jeopardy. Any such change could cause market chaos, enormous economic losses, lawsuits, and takings claims.

Local Flexibility

The legislature designed the current groundwater regulatory system to allow districts flexibility. GDCs can develop and implement a regulatory system utilizing a permissive regulatory toolbox that is adaptable to the local area. Local hydrogeological conditions are considered. This system protects the investments and property rights of all landowners in the area and affords each a "fair share" of the groundwater resources. Any significant statutory change to that framework at this point in time would have much more negative impacts to property rights and the economy than whatever good might be accomplished by such a change.

Property Rights Impacts

Texas Groundwater

Additional GW Factors

Commodity Use v. Groundwater Use

Regulatory Authority v. Takings

It is possible to further fine tune fair share and correlative rights in groundwater regulation. However, to have a positive outcome, any attempt to amend Chapter 36 to reinforce fair share or correlative rights in the regulation of groundwater must be made thoughtfully and with consideration of the complex web of existing law. Oil and gas law provides guidance in understanding how regulations are designed and tweaked over time to afford mineral owners the opportunity to produce their fair share of the minerals. It is critical to remember that groundwater regulation is different and must take into account additional factors not considered in oil and gas law — specifically in the context of affording landowner's their fair share, as stated by the Court in *Day*.

Conclusion

Based on the reality that oil and gas is nonrenewable and used solely as a commodity once produced, the primary consideration in its regulation is to efficiently produce every last drop while providing landowners a fair opportunity to extract and market their fair share of the oil and gas beneath the surface. While one consideration of groundwater regulation is to afford landowners their fair share, other important considerations that shape its regulation are irrelevant to the regulation of oil and gas.

Groundwater specific considerations include: historical usage; future needs; the relative importance of its various uses (such as agricultural uses, municipal uses, recreational uses, domestic and livestock uses, commercial uses etc.); as well as concerns unrelated to use — such as environmental impacts and subsidence.

As stated by the Court in *Day* and set forth in Chapter 36, regulation that permits and allocates groundwater production differs from oil and gas. It is true that over time improvements to Chapter 36 or local rules adopted by GCDs may be necessary in order to achieve long-term groundwater management goals and protect private property rights.

In light of *Day*, it is no longer a fruitful use of time to argue that the Texas Legislature should change the system by which groundwater is regulated to mimic the regulatory system from oil and gas — no more so than it would be to argue that the legislature or the courts should now determine that there is no vested ownership right in groundwater in place. The legislature must provide districts the regulatory authority and tools necessary to accomplish their purposes, and to the extent regulation goes too far as to constitute a taking, property owners may then pursue judicial remedies. It is not the legislature's responsibility to determine what constitutes a regulatory taking or any particular landowner's "fair share" of the groundwater resource; that is a fact-sensitive analysis best left to the courts.

For Additional Information:
Shauna Fitzsimmons Sledge, Sledge Law Firm, 512/ 579-3603 or sfitzsimmons@sledgelaw.com

Shauna Fitzsimmons Sledge is an attorney and government relations consultant at SledgeLaw, PLLC, in Austin She focuses her practice primarily on water and legislative matters. Shauna is partner of the firm, and is a frequent speaker on legislative, water, environmental, and local government issues. Shauna represents landowners, businesses, industries, public and private water utilities, river authorities, cities, groundwater conservation districts, and other political subdivisions in matters involving regulation and planning, surface water and groundwater rights, water quality, water resource development and management strategies, real property transactions, environmental permitting, oil and gas, litigation, board governance, open government, and other local government issues. Shauna is also a registered lobbyist with an active practice at the Texas Capitol and state agencies.

Footnotes

1) *Houston & T. C. Ry. Co. v. East*, 81 S.W. 279, 280-82 (Tex. 1904).
2) *Tex. Co. v. Daugherty*, 176 S.W. 717, 720 (Tex. 1915).
3) *See e.g. Sipriano v. Great Spring Waters of Am., Inc.*, 1 S.W.3d 75, 76 (Tex. 1999) (citing *Houston & T. C. Ry. Co. v. East*, 81 S.W. 279 (Tex. 1904); *see also Friendswood Development Co. v. Smith-Southwest Industries, Inc.,* 576 S.W.2d 21 (Tex. 1978) (adding negligence as a ground for recovery in subsidence).
4) *See Sipriano*, 1 S.W.3d at 78-80, *Friendswood Development Co.,* 576 S.W.2d 21, *City of Corpus Christi v. City of Pleasanton*, 276 S.W.2d 798, 799 (Tex. 1955).
5) Tex. Const. art. XVI, § 59(a).
6) Tex. Water Code Ann. § 36.0015.
7) *See* Senate Bill 1, Act of June 1, 1997, 75th Leg., R.S., ch. 1010, 1997 Tex. Gen. Laws 3610.
8) *See* Corwin W. Johnson, *The Continuing Voids in Texas Groundwater Law: Are Concepts and Terminology to Blame*, 17 St. Mary's L.J. 1281 (1986).
9) *See* Senate Bill 332, Act of June 17, 2011, 82nd R. S., ch. 1207, 1 Tex. Gen. Laws 3324.
10) *See* Tex. Water Code § 36.002(a)-(b),(b-1).
11) *Id.* § 36.002(b-1).
12) *Id.* § 36.002(d).
13) *Edwards Aquifer Authority v. Day,* 369 S.W.3d 814 (Tex. 2012).
14) *Id.* at 831-832 (citing *Elliff v. Texon Drilling Co.*, 210 S.W.2d 558, 562-63 (Tex. 1949)).
15) *Day*, 369 S.W.3d at 831-32 (citing *Elliff*, 201 S.W.2d at 561). This case was followed by civil appeals court rulings supporting the right of a landowner to sue for a regulatory taking of groundwater rights and outlining the measure of damages. *See Edwards Aquifer Auth. v. Bragg*, 421 S.W.3d 118 (Tex. App.—San Antonio 2013, pet. denied).
16) *Day*, 369 S.W.3d at 832.
17) *Id.* at 831-832 (citing *Elliff*, 201 S.W.2d at 561).
18) *See id.* at 828 (citing *Sipriano v. Great Spring Water of America, Inc*., 1 S.W.3d 75, 79 (Tex. 1999)).
19) *See e.g. Day,* 369 S.W.3d at 828-829 (citing *Stephen County et al. v. Mid-Kansas Oil & Gas Co*., 254 S.W.290, 292 (Tex. 1923), *Elliff v. Texon Drilling Co*., 210 S.W.2d 558, 561 (Tex. 1948), *Coastal Oil & Gas Corp. v. Garza Energy Trust*, 268 S.W.3d 1, 14 (Tex. 2008)) (describing the interplay between the rule of capture and ownership in place, in the context of oil and gas and now applicable in groundwater).
20) *Day*, 369 S.W.3d at 824-829, 838 (citing *Sheffield Development Co. v. City of Glenn Hieghts*, 140 S.W.3d 660, 670 (Tex. 2004) (quoting *Pa. Coal Co. v. Mahon*, 260 U.S 393, 413, 416 (1992)).
21) *Del Rio v. Clayton Sam Colt Hamilton Trust*, 269 S.W.3d 613 (Tex. App.—San Antonio 2008, pet denied).
22) *Coyote Lake Ranch, LLC v. City of Lubbock*, 498 S.W.3d 53, 64 (Tex. 2016).
23) *Id.*

24) *Edwards Aquifer Authority v. Day,* 369 S.W.3d 814, 840-841 (Tex. 2012).
25) *See id.*; *see also* Texas Water Development Board, Aquifers of Texas, Report 380, 18 (2011) *available at:* www.twdb.texas.gov/publications/reports/numbered_reports/doc/R380_AquifersofTexas.pdf (explaining the different characteristics of different aquifers in Texas).
26) *See* Texas Water Development Board, *supra* note 25; *see also* United States Geological Survey, Groundwater Recharge to the Gulf Coast Aquifer System in Montgomery and Adjacent Counties, Texas (August 2013) *available at* https://pubs.usgs.gov/fs/2013/3043/pdf/fs2013-3043.pdf (explaining that recharge rates even within the same aquifer can vary).
27) *See Day*, 369 S.W.3d at 840; *see generally* Texas Water Development Board, *supra* note 25, United States Geological Survey, *supra* note 26.
28) *See Day*, 369 S.W.3d at 831, 840-841.
29) *Id.* at 840-841.
30) *Id.* at 831.
31) *See id.* at 841; *see also* Texas Water Conservation Association, The Application of Oil and Gas Law to Groundwater: Analyzing Correlative Rights and So-Called "User-Based Rules" 3-4 (2017) (identifying instances where oil and gas law is differentiable from groundwater law).
32) *See* Texas Water Conservation Association, *supra* note 31, at 3-4.
33) *Id.*
34) *See* Tex. Nat. Res. Code Ann. § 81.051.
35) Texas Water Development Board, Groundwater Conservation Districts of Texas Map, www.twdb.texas.gov/mapping/doc/maps/GCDs_8x11.pdf?d=38941.800000029616.
36) Tex. Water Code § 36.008.
37) *Id.* §§ 36.1071(e), 36.108(c), 36.1132, 36.3011(b) & (h), 36.303.
38) *See* Tex. Nat. Res. Code §§ 85.202(a) (requiring the rules and orders adopted by the Railroad Commission to prevent waste, as defined by 85.046, and to require wells to be drilled and operated in a manner that will prevent injury to adjoining property), 86.001 (regarding the regulation of gas production), 91.002 (providing that it is the intent of the legislature that the mineral resources of this state be fully exploited).
39) *See* Tex. Water Code §§ 36.0015(b), 36.1071, 36.108(d-2), 36.1132(b).
40) *Coyote Lake Ranch, LLC v. City of Lubbock*, 498 S.W.3d 53, 63 (Tex. 2016) *(citing Sipriano v. Great Spring Water of America, Inc*., 1 S.W.3d 75, 76 (Tex. 1999) (recognizing the rule of capture and allowing suit for wasteful drainage of groundwater), *Elliff v. Texon Drilling Co.,* 210 S.W.2d 558, 562–563 (Tex. 1948) (recognizing the rule of capture and allowing suit for wasteful drainage of oil and gas)) .
41) Tex. Nat. Res. Code §§ 85.046, 91.015
42) Tex. Water Code §§ 36.001(8), 36.0015(b).
43) House Committee on Natural Resources, Texas House of Representatives, Interim Report to the 86th Texas Legislature 56 (December 2018) (citing Oral and Written Testimony of Shauna Fitzsimons Sledge, SledgeLaw Group PLLC, Public Hearing, Texas House of Representatives Committee on Natural Resources, Canyon, Texas, June 5, 2018).
44) *Id.*
45) *See Elliff v. Texon Drilling Co*., 210 S.W.2d 558, 583 (1948).
46) *See id.* at 562 (citing *Stephens County v. Mid-Kansas Oil & Gas Co*., 113 Tex. 160 (1923)).
47) *See id.*
48) *Edwards Aquifer Authority v. Day,* 369 S.W.3d 814, 830 (Tex. 2012).
49) *See Elliff*, 210 S.W.2d at 562.
50) *See* Tex. Nat. Res. Code § 81.05-81.052; *see generally* Tex. Nat. Res. Code Ch. 85-111.
51) The Railroad Commission adopts specific field rules to accommodate unique circumstances existing within particular production areas, including circumstances that require more specific rules to prevent waste or confiscation. *See Seagull Energy E & P*, 226 S.W.3d 383, 389 (Tex. 2007).
52) *See Browning Oil Co. V. Luecke*, 38 S.W.3d 625, 633-34 (Tex. App.—Austin 2000, pet. denied).
53) 16 Tex. Admin. Code 3.37(a)(1).
54) *See Luecke*, 38 S.W.3d at 634.
55) 16 Tex. Admin Code § 3.38.
56) *See Luecke*, 38 S.W.3d at 633.
57) 16 Tex. Admin. Code § 3.38(a)(3).
58) *Luecke*, 38 S.W.3d at 634; 16 Tex. Admin. Code § 3.38(a)(3).
59) 16 Tex. Admin. Code § 3.40(d).
60) *See Endeavor Energy Res., L.P. v. Discovery Operating, Inc*., 554 S.W.3d 586, 596 (Tex. 2018) (citing *Browning Oil Co. v. Luecke*, 38 S.W.3d 625, 634 (Tex. App.—Austin 2000, pet. denied).
61) 16 Tex. Admin. Code §§ 3.37(a)(3),(h), 3.38(f).
62) *See id.* §§ 3.37(h), 3.38(f). Note that there are exceptions to the notice and hearing requirement.
63) *R.R. Comm'n v. Williams*, 163 Tex. 370, 378, 356 S.W.2d 131, 136 (1961).
64) *Id.* (citing *Brown v. Humble Oil & Refining Co.,* 87 S.W.2d 1069 (Tex. 1935), *Railroad Commission of Texas v. Gulf Production Co*., 132 S.W.2d 254 (Tex. 1939)).
65) *Id.* (citing Robert E. Hardwicke, *Oil-Well Spacing Regulations and Protection of Property Rights in Texas*, 31 Tex. Law Rev. 99 (reasoning that if the rule, each tract is entitled to a first well as a matter of law, means that the commission may not ignore its own rules, and that tracts subdivided before Rule 37 or the discovery of oil or gas shall be entitled to a well to prevent waste or confiscation, then the rule is sound; if it means that each tract is entitled to a well regardless of the development in the area by the applicant and others, then the rule is not sound)).
66) *Id.* (upholding the Railroad Commission's denial of a permit to drill as an exception to the spacing requirements because the landowner applying for the permit was already receiving his fair share of the oil beneath his tract by participating in a well on an adjoining tract) (finding that one may not claim a right to a well permit on a substandard tract, as an exception to the spacing rules and on the ground of confiscation, when one's grantor did not have such as a right).
67) *See id.*
68) *See Elliff v. Texon Drilling Co*., 210 S.W.2d 558, 583 (Tex. 1948).
69) *See Friendswood Dev. Co. v. Smith-Sw. Indus., Inc*., 576 S.W.2d 21, 30 (Tex. 1978) (adding negligence as a ground for recovery in subsidence).
70) *See Sipriano v. Great Spring Waters of Am., Inc.*, 1 S.W.3d 75, 79-80 (Tex. 1999).
71) *See Edwards Aquifer Authority v. Day,* 369 S.W.3d 814, 840 (Tex. 2012).
72) *See id.* at 830.
73) *Id.*
74) *See* discussion *supra* Part I(B).
75) *See Day*, 369 S.W.3d at 841.
76) *See id.* at 839.
77) *See id.* at 831.
78) *See Edwards Aquifer Auth. v. Bragg*, 421 S.W.3d 118 (Tex. App.—San Antonio 2013, pet. denied).
79) Tex. Water Code Ann. § 36.0015(b).
80) *Id*. §§ 36.101(a), 36.102, 36.3011(b)(8)-(9), (h)(8)-(9).
81) *Id*. § 36.113(a).
82) *Id*. § 36.116(a)(1)-(2).
83) *Id.* § 36.117.
84) *Id.* § 36.117(b)(2).
85) *Id.* § 36.117(b)(3). These water wells are also exempt from a district's well spacing requirements. *Id.* § 36.117(f).
86) *Id.* § 36.116(a)(2)(A)-(F).
87) *Id.* § 36.116(e)(1).
88) *Id.* § 36.116(b).
89) *Id.* § 36.113(e).
90) *Id*. § 36.116(c).
91) *Id.* §§ 36.1132(a)-(b), 36.3011(b)(7)-(9),(h)(7)-(9).
92) *Id.* § 36.108.
93) *Id.* § 36.1116(d)(1)-(2).
94) *See* Shauna N. Fitzsimmons, *Understanding Groundwater Production Allocation and the Permitting Process in Texas,* Changing Face of Water Rights, State Bar of Texas (2018).
95) *See generally* Texas Water Conservation Association, *supra* note 31 (providing a detailed discussion on the different methods districts use to allocate groundwater production).
96) *Id.*
97) See for example Senate Bill 1392, Tex. S.B. 1392, 85th Leg., R. S. (2017), and House Bill 3028, Tex. H.B. 3028, 85th Leg., R.S. (2017).
98) House Committee on Natural Resources, *supra* note 43, at 61.
99) *Seagull Energy E & P, Inc. v. R.R. Comm'n*, 226 S.W.3d 383, 389 (Tex. 2007).
100) *R.R. Comm'n v. Gulf Prod. Co.*, 132 S.W.2d 254, 255 (Tex. 1939).
101) *See* House Committee Natural Resources, *supra* note 43, at 61 (citing Oral and Written Testimony of Wade Oliver, INTERA, Public Hearing, Texas House of Representatives Committee on Natural Resources, Brownsville, Texas, September 27, 2018) (addressing the extreme variability in aquifer conditions across the state and even within the same aquifer).

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INFRASTRUCTURE EVOLUTION

MARKING THE ERA IN 2020: A NEW PARADIGM FOR WATER QUALITY INFRASTRUCTURE

by Joan Card, Culp & Kelly, LLP (Boulder, CO)

Use the word 'zeitgeist' as often as possible. Ideally, you want to find words that sound familiar but people don't really know their definitions: 'zeitgeist,' 'bildungsroman,' 'doppelganger' - better yet, anything Latin. But avoid 'paradigm.' It's so 1994. If you say the word 'paradigm,' everybody knows you're a poser.
-Stephen Colbert-

Bring me men to match my mountains: Bring me men to match my plains:
Men with empires in their purpose and new eras in their brains.
-Sam Walter Foss-

Introduction

The development of "infrastructure" to manage water resources surely dates to the dawn of human settlements. However, little about the basic concepts of water resource management changed when Europeans settled North America. Not until about the mid-20th century did Americans begin to generally approach water management in a fundamentally different way — through the construction and operation of large-scale mechanical and electrical systems to distribute, collect, pump, and treat water. The 1950s through the 1980s marked an era of explosive growth in the construction of federally-funded "gray" (constructed, often concrete) infrastructure for water resource management, improved public health, and regulatory compliance.

The precipitous decline in federal funding for water quality infrastructure with the shuttering of the Clean Water Act Construction Grants Program in the 1980s and the policy shift away from Congressional earmarks for water projects are driving significant changes in local water resource management, and the emergence of a new paradigm of water quality infrastructure. This article: 1) outlines the recent history of gray infrastructure solutions to address the needs of a growing nation, its public health, and regulatory compliance; and 2) highlights the rise and fall of federal funding for gray infrastructure and the development of current initiatives that redefine water quality infrastructure to include nature-based and innovative programmatic solutions to contemporary water compliance and management challenges.

Background

BRIEF HISTORY OF RECENT WATER QUALITY REGULATION & GRAY INFRASTRUCTURE IN THE US

Centralized systems of water distribution have been utilized in human settlements across the globe since ancient times. By the modern industrial era, in the late 19th century, water-borne disease was more studied and eventually understood.[1] In the early 20th century, to address outbreaks of deadly cholera and typhoid, sand filtration was employed at scale in larger urban water systems. In 1908, Jersey City, New Jersey became the first municipality in the United State to use chlorine to disinfect its drinking water supply.[2] This era marked a turning point in public health, as the construction of gray infrastructure to provide water sanitation, over the span of a few short decades, is credited with wide-spread and dramatic decreases in the number of cases of infectious diseases.

Drinking Water

National regulation of drinking water in the United States is rooted in more than a century of work by the United States Public Health Service (PHS).[3] In 1912, Congress passed the Act creating the agency. The Act consolidated certain existing authorities and authorized the PHS to "study and investigate the diseases of man and conditions influencing the propagation and spread thereof, including sanitation and sewage… ."[4] By 1914, the PHS had established standards related to bacteria in drinking water that applied to common carriers in order to protect the traveling public.[5] Over the following decades, the PHS revised and expanded drinking water standards, and by 1962, the PHS had issued "the most comprehensive federal drinking water standards in existence before the Safe Drinking Water Act of 1974."[6] The 1962 standards were intended to protect drinking water consumers more generally and were adopted by all 50 states.[7] Although these standards contained limitations related to 28 contaminants, compliance was lackluster. By 1969, a survey by the PHS indicated that only 60% of United States (US) systems surveyed delivered water for consumption that met all the 1962 standards.[8]

Infrastructure

"SDWA"

Congress passed the nation's first comprehensive legislation to address drinking water quality with its passage of the Safe Drinking Water Act of 1974 (SDWA).[9] It established a national drinking water program at the nascent US Environmental Protection Agency (EPA). The SDWA was designed to maintain the primary responsibility of states to ensure provision of safe drinking water by local entities. The SDWA authorized EPA to: set protective national standards for drinking water; assist states in ensuring compliance with those standards; and provide for federal enforcement either if states fail to act or in cases of imminent health hazard to the public.

Sewage & Sanitation

Sewage Collection & Treatment

Better sanitation from drinking water treatment practices wasn't the only reason for the notable improvements in public health in the United States early in the 20th century. The construction of centralized systems to collect sewage in the mid- to late 19th century also contributed to increased sanitation and reduced water-borne disease. With the introduction of centralized water distribution and utilization of the flush toilet, sewage collection systems were constructed in our relatively young nation's rapidly growing urban areas — replacing decentralized and ubiquitous privies and cesspools.[10] These systems eventually rid cities of standing sewage in streets and alleys. However, as designed, the collected sewage was generally carried downstream.

Nuisance Conditions

Dry weather discharges of untreated sewage to streams and rivers used for drinking water supplies contributed to widespread nuisance conditions in many of the nation's lakes, rivers, and streams. Eventually, these longstanding and increasingly ubiquitous nuisance conditions prompted Congress to pass comprehensive federal legislation intended to eliminate the discharge of pollutants and restore the nation's waters to fishable, swimmable, and drinkable quality.

"CWA"

"NPDES"

Secondary Treatment

A major amendment to the Federal Water Pollution Control Act (enacted in 1948), the 1972 "Clean Water Act" (CWA) imposed a national requirement for municipal sewage and industrial wastewater. Such effluent was to be treated to prescribed standards prior to discharge under the CWA's National Pollutant Discharge Elimination System (NPDES) permit program.[11] At the outset of the NPDES program, discharges from municipal sewage treatment works were required to meet "secondary treatment" standards. These standards entailed sewage treatment technology involving: first, a primary processes of screening, sedimentation, and skimming; and second, biological removal of residual organic matter.[12] These requirements, along with a program of major federal investment, resulted in the elimination of nuisance conditions in rivers and streams formerly used as wasteways for sewage.

Stormwater Management

Combined Sewer Systems

In the mid-19th century, municipalities, principally along the eastern seaboard and in the upper Midwest designed their sewage collection systems to collect rainwater in addition to sewage.[13] These "combined sewer systems" were initially designed to effectively manage (though not necessarily treat) the collection of sewage during dry weather. However, during wet weather these systems were overwhelmed and designed to allow the wastewaters to "escape" to waterways in order to prevent backups into buildings.[14] Once developed, centralized sewage treatment facilities associated with combined sewers generally were not sized to handle sewage combined with a deluge of stormwater. As a result, in wet weather "**c**ombined **s**ewer **o**verflows" (CSOs) continue to threaten some of the nation's waters with sporadic discharges of sewage.

Combined Sewer Overflows (CSOs)

Combined sewers are not yet a mere a relic of history. According to EPA, approximately 860 communities with a total population of about 40 million people live in communities served by combined sewers.[15] CSOs increase the number of microbial pathogens in drinking, fishing, and recreational waters. This pollution can lead to gastrointestinal illness, exposures from contaminated fish, beach closures, and fish kills.[16]

"MS4s"

Municipal Requirements

Though CSOs may have outsized impacts on water quality in certain regions, the vast majority of municipal stormwater in the US is managed by gray infrastructure that is separated from, rather than combined, with the sanitary sewer. EPA refers to this type of stormwater infrastructure as "**m**unicipal **s**eparate **s**torm **s**ewer **s**ystems" (MS4s).[17] The 1987 amendments to the Federal Water Pollution Control Act added specific requirements under the NPDES program for stormwater discharges.[18] EPA first enacted regulations to implement these stormwater requirements in 1990 for MS4 cities with populations greater than 100,000[19] (Phase 1). In 1999, Phase II was enacted for smaller cities and defined urbanized areas.[20] In general, MS4 permits require the use of management practices and control techniques to prohibit non-stormwater discharges to MS4s and "reduce the discharge of pollutants [from stormwater] to the maximum extent practicable."[21]

The Rise and Fall of Federal Investment

With passage of the CWA in 1972, Congress recognized that the newly-imposed requirements to meet secondary treatment standards and, eventually, state water quality standards would require the design

Infrastructure

CWA Grants

Decades of Funding

Unprecedented Improvements

SDWA Costs

Funding Downturn

Local Cost Share Increase

Projected Needs

Under Funding

Shortfall Driving Innovation

New Paradigm

and construction of state-of-the-art gray infrastructure, especially municipal sewage treatment plants. Accordingly, the CWA greatly expanded existing authority for very large federal grants for such facilities, known as the Construction Grants Program. The CWA authorized the use of these grants for up to 75% of the cost of construction and allowed the grants to be used for sewage collection systems and CSO management, in addition to sewage treatment plants.[22]

According to one report, between 1972 and 1984 Congress appropriated nearly $41 billion to the Construction Grants Program "representing the largest nonmilitary public works programs [sic] since the Interstate Highway System."[23] According to another report, EPA issued $100.7 billion in federal *grants* (not loans!) for construction of sewage collection and treatment infrastructure between 1970 and 1995.[24] The result, of course, was the construction of gray water quality infrastructure at a massive scale. Between 1972 and 1986, 4500 sewage treatment facilities funded by the Construction Grants Program became operational, and as of 1986 "several thousand" additional Construction Grants projects were in design or construction.[25] The Program contributed to unprecedented — and since unmatched — water quality improvements in the nation's rivers and lakes. By 1982 the Program had ensured 57 million more people were served by plants with secondary treatment technology than were served by such plants in 1972.[26]

The trajectory of federal investment in drinking water infrastructure tells a somewhat different story. Prior to the early 1980s drinking water treatment costs nationally were relatively low as the regulatory requirements were relatively small. However, as the number of contaminants studied for human health effects increased, so did the regulatory requirements for drinking water systems. Between 1986 and 1996, the number of primary drinking water regulations issued by EPA pursuant to the Safe Drinking Water Act increased from 23 to 83.[27] By 1986, the federal government's role in water quality infrastructure investment was already taking a precipitous downturn. Since then, local water agencies have borne the responsibility to fully fund drinking water treatment plants without the benefit of federal investment like the Construction Grants Program.

According to Congressional Budget Office data, in 2017, water utilities in the US spent $113 billion on capital projects and operations and maintenance — the federal government's share of that amount was 4%.[28] By contrast, in the late 1970s the federal government's share was approximately 25%.[29] This gap has ensured that today, water utility rate payers and property owners fund the vast majority of the nation's water quality infrastructure. However, the need for water quality infrastructure is enormous and growing and the costs are climbing.

The Drinking Water State Revolving Loan Fund (DWSRF) was established by the 1996 amendments to the SDWA. The DWSRF is a financial assistance program to help water systems and states achieve the health protection objectives of the SDWA. As of March 2018, results of the DWSRF needs survey indicate that $472.6 billion is needed to maintain and improve the nation's drinking water infrastructure over the next 20 years.[30]

As of January 2012, EPA estimated "the total documented POTW [**p**ublicly **o**wned **t**reatment **w**orks] capital investment needs required to address water quality or water quality-related public health problems… totaled $271 billion.[31] In 1996, EPA estimated that CSO control was expected to cost $44.7 billion.[32] Despite these needs, in 2005 Congress' total appropriation to EPA for water infrastructure funding was $2.3 billion (matching 1988's appropriation).[33] By 2019, that number ticked up to just under $2.9 billion.

Ongoing Programs & New Initiatives

REDEFINING WATER QUALITY INFRASTRUCTURE

Regardless of the lack of meaningful growth in EPA water infrastructure funding over the last four decades, our past investments in gray water quality infrastructure have resulted in major improvements in water quality and public health. But water quality compliance challenges and infrastructure needs remain. There will be no end to the need for gray infrastructure to meet regulatory compliance and the funding gap seems impossible to fill. This shortfall is driving innovations and fundamental changes in our approaches to water quality compliance and reframing our assumptions about what defines water quality infrastructure. Broader, more inclusive ideas about what comprises water quality infrastructure — a new paradigm — are offering more opportunities and solutions for local water agencies, ratepayers, and even private investors, to meet our ever-growing water quality infrastructure needs.

Given the last several decades of water quality regulation and resulting infrastructure construction, there is a tendency to assume water quality infrastructure merely is a system of pipes, pumps, and concrete — i.e., gray infrastructure. But infrastructure is just that — a system. Webster's defines infrastructure as "the system of public works of a country, state, or region" and "the underlying foundation of basic framework (as of a system or organization)."[34] Under the new paradigm, administration of more environmentally beneficial projects and programs designed to achieve regulatory compliance and improve water quality are a system of public works akin to the traditional gray infrastructure ones. Acknowledging and accepting this new paradigm can normalize and expand opportunities for conceiving, funding, and

Infrastructure

constructing innovative and sustainable "non-gray" water quality infrastructure — and help ensure that much-needed public and private investment continues and grows. [*See* also, "*Financing Green Stormwater Infrastructure*" Brown & Sannerman, *TWR* #163.]

Established Examples

Watershed Protection

The concept is not new. There are well-known and well-accepted examples of effective water quality programs that don't center on gray infrastructure. Watershed protection programs may be among the first and most common types of water quality infrastructure that is not based on a system exclusively of pipes, pumps, and concrete. Large-scale watershed protection programs in the United States date back at least to the 1897 Organic Administration Act in which Congress reserved national forests for two purposes: to conserve water flows and to furnish timber to the people.[35] Subsequent acts of Congress and Executive Orders included specific authorities and requirements for watershed protection, including water quality protection in our budding National Forest System to benefit municipal water supplies.

Municipal Supply

As an early and still ongoing example, President Theodore Roosevelt issued an order in 1906 to reserve the rugged forested watershed in the Wasatch Mountains east of Salt Lake City as a "nursery site" for maintenance of the municipal water supply.[36] Since that time, the federal government and Salt Lake City have worked together to manage the federal lands comprising Salt Lake City's watershed to protect it for drinking water use.[37] The watershed within the Wasatch-Cache-Uintah National Forest and its administrative programs are a critical part of Salt Lake City's water quality infrastructure.

New York City Watershed

Perhaps the most widely known example of a watershed protection program for regulatory compliance is New York City's Catskill/Delaware program, which has resulted in the protection of water quality across nearly 2,000 square miles and nine counties. New York City has constructed water quality infrastructure on a landscape scale to meet water quality goals. This program utilizes: an effective watershed-based system of land acquisition; appropriate regulations; targeted water quality improvement projects; and voluntary agricultural best management practices.[38] The program was conceived in response to EPA's 1989 Surface Water Treatment Rule.[39] Since 1993 it has allowed the City to avoid mechanically filtering the Catskill/Delaware water supply — thereby avoiding billions of dollars in new gray infrastructure costs.[40]

Avoided Costs

Watershed protection programs like these perfectly illustrate the role of both institutions and nature as forms of water quality infrastructure.

Recent Exemplary Infrastructure Innovations

"GSI"

Green **s**tormwater **i**nfrastructure (GSI) urban retrofits for CSO management are the first non-gray infrastructure projects broadly understood and accepted by the water community as being "water quality infrastructure." But even GSI retrofits are a relatively recent addition to water utility capital portfolios and plans. Cities like Philadelphia, Atlanta, and Cleveland were among the large-city early adopters of deploying GSI in response to EPA enforcement actions to address CSO violations.[41] Philadelphia alone plans to spend $2.4 billion on GSI with the goal of creating the largest system of GSI urban retrofits in the US by the mid-2030s.[42] While this investment may seem large and risky, estimates suggest that a system of gray infrastructure to manage CSOs in Philadelphia would cost an estimated $9.6 billion and also involve the typical risks of large gray infrastructure projects.[43]

Urban Retrofits

The evolution of GSI as an investable water quality infrastructure option at scale for city governments has been relatively short. Acceptance by the principal CSO regulator, EPA, has been relatively recent. In 2007, EPA's Office of Water issued a memorandum defining green infrastructure and its benefits to "highlight opportunities for the [EPA] Regions, States, and Headquarters efforts to increase the development and use of green infrastructure in water program implementation."[44] This followed EPA's 2004 report to Congress and its summary of "low impact development" solutions for managing stormwater (this report does not use the phrase green infrastructure or GSI).[45] It wasn't until many years after adoption of the concept by federal, state, and local agencies that Congress defined the phrase green infrastructure in statute. The Water Infrastructure Improvement Act of 2019 amended the Clean Water Act and "to promote green infrastructure."[46] GSI now enjoys broad acceptance as a new kind of water quality infrastructure.

"Low Impact Development"

GSI is the foremost alternative to gray water quality infrastructure and water utilities continue to pursue alternative infrastructure innovations to manage water quality compliance challenges. Water utilities are increasingly investing in watershed-based water quality infrastructure. A water utility may fund extra-jurisdictional infrastructure. This infrastructure includes: stream bank revegetation; stream and wetland restoration; forest management; buffer strips adjacent to fields; and other water quality best management practices related to agriculture. While typically situated on lands within the utilities' watersheds, these lands are also typically well outside the utilities' jurisdictions. In most cases, these extra-territorial infrastructure projects and program investments may represent generalized watershed protection efforts with unquantified returns. However, in a growing number of situations, a water utility's extra-jurisdictional programs and nature-based infrastructure projects do yield quantifiable avoided costs to ratepayers, as well as credit for compliance with enforceable requirements to meet water quality standards and permit conditions.

Extra-Jurisdictional Infrastructure

Compliance Credit

Infrastructure

Shade Trees

Temperature "TMDL"

Chilling Costs

Maintenance & Monitoring

Thermal Credits

Nutrients & Sediment

Crediting Metrics

"Pay-for-Success"

Failure Risk Shifts

Needs Unabated

Concept Standardization

One of the earliest examples of an extra-territorial water quality infrastructure project has been underway in Oregon for the last decade. Native shade trees planted along the banks of the Rogue River are being planted and nursed as a component of the water quality infrastructure portfolio of the City of Medford. Medford's sewage treatment facility discharges treated water to the Rogue River in south central Oregon, roughly 20 miles north of the California border. The Rogue River is habitat for cold water fishes, namely trout and salmon, and was identified by the Oregon Department of Environmental Quality (ODEQ) as impaired due to water temperature exceeding the water quality standards for cold water fisheries.[47] ODEQ identified "removal of near stream vegetation leading to increased solar radiation reaching the water" as a principal source of the water temperature problem.[48] After ODEQ developed a Total Maximum Daily Load (TMDL), as required by the Clean Water Act[49] to address the Rogue River temperature impairment, Medford was faced with conditions in its NPDES permit to meet the temperature requirements of the TMDL.

One gray infrastructure option for reducing the temperature of water discharged from a sewage treatment facility is to construct and operate a cooling tower to chill the water prior to discharge. Medford was faced with the prospect of spending $15 million or more on such a facility.[50] Medford, along with ODEQ, an environmental group called Willamette Partnership, and a few other key stakeholders, opted instead to work together to create a water quality trading program that allows the City to sponsor stream-side revegetation projects. The required maintenance and monitoring of these shade-creating projects mitigates the effects of City discharges on river temperatures while generating water quality credits and achieving permit compliance.

ODEQ incorporated the tree planting program in Medford's NPDES permit issued in December 2011.[51] The NPDES permit requires the City to complete at least one tree planting project per year between 2013 and 2022 to obtain "thermal credits" representing the anticipated reductions in temperature needed to mitigate the increased river temperatures resulting from their discharge.[52] The permit includes a special condition that outlines the parameters of the requirements for the trading program.[53] The value of the thermal credits, and the methodology for calculating it, are described in a Thermal Credit Trading Plan.[54] The plan calls for revegetation along approximately 40 stream miles and the offset of 400 million kilocalories of temperature pollution by 2030.[55] Reports indicate that the City expects to avoid over $8 million in gray infrastructure capital costs by implementing this program.[56]

On the opposite side of the country, the City of Newark, Delaware utility will fund the construction of extra-jurisdictional water quality infrastructure on farms in the Brandywine-Christina watershed of the Delaware River basin. Agricultural impacts in this watershed are causing nutrient and sediment problems. The project includes the construction of bio-swales, stream buffers, and exclusion fencing designed to improve water quality upstream of the City's service area.[57] Newark holds an NPDES permit for discharges of stormwater from its MS4 and aims to meet certain conditions of its renewed permit, as well as improve drinking water source quality, with the construction of the new on-farm water quality infrastructure.[58]

Newark and other partners are working with the Delaware Department of Natural Resources and Environmental Control (DDNREC) to develop science-based metrics for crediting the City's on-farm projects toward compliance with its NPDES permit.[59] The City has agreed to use an innovative finance structure — called "pay-for-success" — financing, that essentially utilizes private entities to finance and construct the on-farm water quality infrastructure up front. Using the metrics eventually established by the DDNREC, the City will pay the private entities if the projects are deemed successful at improving water quality while having no obligation if they are not successful.[60] In any event, the structure is expected to be crafted to allow the City to remain in compliance with its permit requirements so long as the pre-defined success metrics are achieved. This type of structure shifts the risk of failure from the City to the investors. If it comes to fruition, this scheme will demonstrate to the City and its ratepayers, as well as to private investors, the value of watershed and program-based water quality infrastructure to achieve compliance with regulatory requirements.

Conclusion

The era of publicly-funded gray infrastructure that resulted in the construction of a large portion of the nation's wastewater treatment infrastructure ended nearly 40 years ago. Regardless, water utilities have, will, and must continue to fund, build, upgrade, and maintain critical drinking water and sewage treatment gray infrastructure.

Utilities increasingly must look for alternatives to costly gray infrastructure to comply with state and federal water quality requirements and meet customer needs. It will take as much innovation as we can collectively muster to fill the colossal gap between water quality infrastructure needs and available funding.

As this article is intended to highlight, one useful step will be standardizing the concept that watershed and nature-based projects and programs are components of a water utility's infrastructure portfolio equally as important as the gray infrastructure components. Such projects include: watershed protection programs; water quality trading and pay-for-success transactions; and distributed solutions — such as green stormwater infrastructure urban retrofits.

Infrastructure

Private Investment

This new way of thinking can help ensure the continued growth of the currently inadequate public acceptance and funding for these innovative projects and programs. Acceptance of this new paradigm by municipal leaders and ratepayers can improve the prospects of local funding and opportunities for private investment in non-traditional municipal water quality infrastructure.

Compliance and increased regulation, CSOs, municipal and industrial stormwater pollution, and vexing nonpoint source pollution problems require effective solutions in the absence of massive investment by the federal government. This is driving innovation and a new era of water quality infrastructure development. The water quality community — EPA, states, cities, water utilities, engineers, NGOs, insurers, and investors — increasingly recognize the wisdom and value of institutional and nature-based solutions to help bridge the water quality infrastructure gap and promote longer-term water quality sustainability.

Compliance Obligations

Many CSO cities are ambitiously investing in retrofitting their jurisdictions with green stormwater infrastructure and some of the plans hold the promise to transform a few communities at scale. By and large though, implementation of green and watershed-based water quality infrastructure suffers from lack of large-scale deployment. This deficiency should not continue to be a result of doubts about green infrastructure's viability. Numerous examples now illustrate how improving water quality in a watershed can help a downstream utility meet its water quality compliance obligations. Unfortunately, the lack of appropriate regulatory tools, adequate funding, and political interest all contribute to the continued imbalance in our use of gray water quality infrastructure over innovative, and in many cases, less costly alternatives.

"H2Ohio"

In 2019, Ohio Governor Mike DeWine demonstrated a bold vision for large-scale deployment of watershed-based water quality infrastructure to address water quality problems in Ohio — especially the nutrient pollution problems plaguing Lake Erie and the communities that use Lake Erie for drinking water. The Governor's ambitious budget called for the creation of a $900 million fund (dubbed "H2Ohio") to pay for projects over a 10-year period to: reduce farm runoff and other sources of sediment; manage lands to improve water quality; and create or restore wetlands.[61] The Governor's proposal did not survive the legislative process intact, though the Legislature did establish a water fund to pay for watershed-based water quality infrastructure at $172 million over two years.[62] Other budget priorities got in the way of the implementation of the Governor's large, sustained vision for funding natural water quality infrastructure in Ohio watersheds. Water infrastructure funding will continue to compete with other funding priorities. Regardless, the Governor's effort illustrates the viability of watershed-based infrastructure to address many of the water quality compliance challenges that downstream utilities face. The Governor's bold public initiative is one of the many and growing indicators of this new era with a new paradigm of water quality infrastructure.

Eliminate Preconceptions

There are many challenges to adequately funding water quality infrastructure, but at least our erroneous pre-conceptions about what is and what is not water quality infrastructure shouldn't continue to be an obstacle for utilities, legislators, and investors when addressing our most challenging water quality problems.

For Additional Information:
Joan Card, Culp & Kelly, LLP, 303/ 325-3755 x3 or JCard@ckblueshift.com

Joan Card is an environmental and natural resources attorney with over 20 years of combined private sector, federal, state, local, and non-profit experience. Joan has held a number of senior executive positions in government agencies and is a solutions-oriented strategic advisor, serving clients in environmental and water quality matters, and in innovative and sustainable urban water management. Her work has taken her from the mountains of Montana to the Colorado River Delta to the halls of Congress and points in between.

Footnotes

1) In 1854, John Snow famously demonstrated that the source of a deadly London cholera outbreak was a drinking water well contaminated by sewage and rotten food. Thirty years later, Louis Pasteur proved the organism *Vibrio cholerae* was the cause of the disease. *See* American Society for Microbiology, *Wells and Wellness Part I: The History of Cholera* (Feb. 20, 2018), www.asm.org/Articles/2018/February/wells-and-wellness-part-i-the-history-of-cholera.
2) Ctr. for Disease Control and Prevention, *History of Drinking Water Treatment*, www.cdc.gov/healthywater/drinking/history.html (last updated Nov. 26, 2012).
3) See U.S. National Library of Medicine, *Images from the History of the Public Health Service*, https://www.nlm.nih.gov/exhibition/phs_history/intro.html (provides a general history of the PHS).
4) 62 Cong., Sess. 11, Ch. 288 (Aug. 14, 1912).
5) USEPA, *The History of Drinking Water Treatment*, EPA-816-F000-006, Feb. 2000.
6) *Id.* at 2.
7) *Id.*
8) *Id.*
9) *See* Safe Drinking Water Act, Pub. L. No. 93-523 (1974).
10) *See generally* Steven J. Burian et al., *Urban Wastewater Management in the United States: Past, Present, and Future*, Urban Technology (2000), www.sewerhistory.org/articles/whregion/urban_wwm_mgmt/urban_wwm_mgmt.pdf.
11) *See* Pub. L. No. 92-500 (1972).
12) 33 U.S.C. § 1313(b)(1)(B).
13) *See* John Tibbets, *Combined Sewer Systems: Down, Dirty, and Out of Date*, Environmental Health Perspectives, Vol. 113, No. 7 (2005), www.ncbi.nlm.nih.gov/pmc/articles/PMC1257666/.

Footnotes (continued)

14) *Id.* at A465.
15) www.epa.gov/npdes/combined-sewer-overflow-frequent-questions.
16) USEPA, *Report to Congress, Impacts and Control of CSOs and SSOs*, at 6-1 to 6-15 (2004).
17) *See* 40 C.F.R. § 122.26(b)(8).
18) Pub. L. No. 100-4, § 405 (1987).
19) 55 Fed. Reg. 47990 (Nov. 16, 1990).
20) 64 Fed. Reg. 68722 (Dec. 8, 1999).
21) *See supra* note 18.
22) *See supra* note 11, at Title II.
23) Cong. Research Serv., *Water Infrastructure Financing: History of EPA Appropriations 1* https://fas.org/sgp/crs/misc/96-647.pdf (last updated April 10, 2019).
24) *See supra* note 16, at 2-7.
25) Jack Lewis, *EPA's Construction Grants Program: A History*, 12 EPA Journal 10 (Nov. 1986).
26) *Id.*
27) USEPA*, Regulation Timeline: Contaminants Regulated under the Safe Drinking Water Act*, www.epa.gov/sites/production/files/2015-10/documents/dw_regulation_timeline.pdf (last updated Sept. 2015).
28) Cong. Budget Office, *Public Spending on Transportation and Water Infrastructure, 1956 to 2017* (2018), www.cbo.gov/system/files/2018-10/54539-Infrastructure.pdf.
29) *Id.*
30) USEPA, *EPA's 6th Drinking Water Infrastructure Needs Survey and Assessment (2018),* www.epa.gov/dwsrf/epas-6th-drinking-water-infrastructure-needs-survey-and-assessment.
31) USEPA, Report to Congress, *Clean Watersheds Needs Survey 2012, 1* (2016), www.epa.gov/sites/production/files/2015-12/documents/cwns_2012_report_to_congress-508-opt.pdf.
32) USEPA, Report to Congress, *Implementation and Enforcement of the Combined Sewer Overflow Control Policy 6-30* (2001).
33) *See supra* note 27, at tbl.1.
34) *Infrastructure*, Merriam-Webster Dictionary, www.merriamwebster.com/dictionary/infrastructure?utm_campaign=sd&utm_medium=serp&utm_source=jsonld (last visited April 2020).
35) *United States v. New Mexico*, 438 U.S. 696, 707 (July 3, 1978).
36) 1906 E.O. 455 (June 6, 1906).
37) LeRoy W. Hooton, Jr., *Salt Lake City Watershed Management Programs: 1847-1997*, https://slco.org/globalassets/1-site-files/watershed/watershed-library/slcwshedmgmtproghistory19471997.pdf; *see also Carpe Diem West Healthy Headwater's Success Story: Salt Lake City, Utah—Remembering Our Relationship With Our Watershed*, www.carpediemwest.org/wp-content/uploads/Salt-Lake-City-Success-Story-SM.pdf.
38) *See generally* NYC Environmental Protection, *About the Watershed*, www1.nyc.gov/site/dep/environment/about-the-watershed.page.
39) 54 Fed. Reg. 27527 (June 29, 1989) codified as amended at 40 C.F.R. Part 141, Subpart H.
40) *See* NY State Dep't of Health, *New York City Filtration Avoidance Determination* (2017), https://health.ny.gov/environmental/water/drinking/nycfad/docs/fad_final_december_2017.pdf.
41) *See* USEPA, *EPA National Enforcement Initiative: Keeping Raw Sewage and Contaminated Stormwater Out of Our Nation's WatersStatus of Civil Judicial Consent Decrees Addressing Combined Sewer Systems* (May 2017), www.epa.gov/sites/production/files/2017-05/documents/epa-nei-css-consent-decree-tracking-table-050117.pdf.
42) Bruce Stutz, *With a Green Makeover, Philadelphia is Tackling its Stormwater Problem*, Yale Environment 360 (Mar. 29, 2018), https://e360.yale.edu/features/with-a-green-makeover-philadelphia-tackles-its-stormwater-problem.
43) *Id.*
44) Benjamin H. Grumbles, USEPA, *Using Green Infrastructure to Protect Water Quality in Stormwater, CSO, Nonpoint Source and other Water Programs* (Mar. 5, 2007), www.epa.gov/sites/production/files/2015-10/documents/greeninfrastructure_h2oprograms_07.pdf.
45) USEPA, *Report to Congress on Impacts and Control of Combined Sewer Overflows and Sanitary Sewer Overflows Fact Sheet*, www.epa.gov/sites/production/files/2015-10/documents/csossortc2004_full.pdf.
46) Pub. L. No. 115-436 (Jan. 14, 2019).
47) *See generally* Julia Crown et al., Oregon DEQ, *Rogue River Basin TMDL* (2008), www.oregon.gov/deq/FilterDocs/rogueChapter1andExecutiveSummary.pdf.
48) *Id*. at I.
49) *See* 33 U.S.C. § 1313(d).
50) Willamette Partnership, *Verifying the Benefits of Restoration*, https://willamettepartnership.org/water-quality-trading/credit-verification/.
51) City of Medford NPDES Permit No. 100985, www.oregon.gov/deq/FilterDocs/MedfordNpdesPermit.pdf.
52) *Id.* at 16.
53) *Id.* at 21.
54) Medford Regional Water Reclamation Facility, *Proposal Medford Regional Water Reclamation Facility Thermal Credit Trading Program*, www.oregon.gov/deq/FilterDocs/MedfordThermalTrading.pdf.
55) *Id.* at 2 tbl. 1.
56) The Freshwater Trust, *Medford Water Quality Trading Program*, www.thefreshwatertrust.org/case-study/medford-water-quality-trading-program/.
57) *See Pay for Success Transaction Designed to Promote Cost-Effective Watershed Conservation*, Businesswire (May 14, 2019), www.businesswire.com/news/home/20190514005629/en/Pay-for-Success-Transaction-Designed-Promote-Cost-Effective-Watershed-Conservation.Document5
58) *Id.*
59) *Id.*
60) *See* Allegra Wrocklage, *Revolving Water Fund Pilots PFS Approach for Water Quality Improvements*, Conservation Finance Network (Aug. 28, 2019), www.conservationfinancenetwork.org/2019/08/28/revolving-water-fund-pilots-pfs-approach-for-water-quality-improvements.
61) *See* Seth A. Richardson, *Mike DeWine said Budget will Include $900 Million to Protect Lake Erie and Other Waterways*, Cleveland.com (Mar. 14, 2019), www.cleveland.com/open/2019/03/mike-dewine-said-budget-will-include-900-million-to-protect-lake-erie-and-other-waterways.html.
62) *See* Bill Stanley, *H2Ohio Fund is a Start as Lake Erie's Algal Blooms Signal Urgency*, Cleveland.com (Oct. 9, 2019), www.cleveland.com/opinion/2019/10/h2ohio-fund-is-a-start-as-lake-eries-algal-blooms-signal-urgency-bill-stanley.html.

WATER BRIEFS

CWA - *MAUI* DECISION US

POLLUTION DISCHARGES / GROUNDWATER

On April 23, the US Supreme Court (Court) in a 6-3 decision decided that a Clean Water Act (CWA) permit is required when pollution flows from a "point source" through groundwater before reaching a "navigable water" that is subject to regulation under the CWA. The Court concluded that the CWA "statutory provisions at issue require a permit if the addition of the pollutants through groundwater is the functional equivalent of a direct discharge from the point source into navigable waters." *County of Maui v. Hawai'i Wildlife Fund, et al.*, 590 U.S. ___ (2020) (*Maui*) *Slip Op*. at 1.

The Court was considering a factual situation where four million gallons a day of municipal sewage effluent was partially treated and then injected into the ground through four wells. The effluent travels about half a mile, through groundwater, to the Pacific Ocean. Maui and the US Solicitor General argued that the statute's permitting requirement does not apply if a pollutant, coming from a "point source," must travel through any amount of groundwater before reaching navigable waters. Justice Breyer, writing for the majority laid out the rationale to reject that position. "If that is the correct interpretation of the statute, then why could not the pipe's owner, seeking to avoid the permit requirement, simply move the pipe back, perhaps only a few yards, so that the pollution must travel through at least some groundwater before reaching the sea?" *Id*. at 10.

"We hold that the statute requires a permit when there is a direct discharge from a point source into navigable waters or when there is the *functional equivalent of a direct discharge*. …That is, an addition falls within the statutory requirement that it be 'from any point source' when a point source directly deposits pollutants into navigable waters, or when the discharge reaches the same result through roughly similar means." *Id*. at 15 (emphasis in original).

The Water Report will be publishing an in-depth article on this important decision in its June issue.

For info: Decision available at: www.supremecourt.gov/opinions/19pdf/18-260_jifl.pdf

WOTUS RULE US

CLEAN WATER ACT SCOPE

On April 21, 2020, EPA and the Department of the Army (the "Agencies") published in the Federal Register the *Navigable Waters Protection Rule* to define "waters of the United States" (WOTUS) as that term is used in the Clean Water Act (CWA). According to an EPA press release, for the first time the agencies are streamlining the definition so that it includes four simple categories of jurisdictional waters, provides clear exclusions for many water features that traditionally have not been regulated, and defines terms in the regulatory text that have never been defined before. Congress, in the CWA, explicitly directed the Agencies to protect "navigable waters." The *Navigable Waters Protection Rule*, commonly referred to as the WOTUS Rule, regulates traditional navigable waters and the core tributary systems that provide perennial or intermittent flow into them. The final rule fulfills Executive Order 13788 and EPA asserts that it reflects legal precedent set by key Supreme Court cases as well as robust public outreach and engagement, including pre-proposal input and comments received on the proposed rule. *See* Federal Register / Vol. 85, No. 77 / Tuesday, April 21, 2020.

The final rule will become on June 22, 2020. Once effective, it replaces the rule published on October 22, 2019.

The June 15th issue of *The Water Report* will include a comprehensive examination of the WOTUS Rule, analyzing the final rule's impacts to water quality protections in Arizona.
For info: EPA website: www.epa.gov/nwpr/final-rule-navigable-waters-protection-rule

KLAMATH DAMS CA/OR

WATER QUALITY CERTIFICATION

On April 7, 2020, the Executive Director of the California State Water Resources Control Board (State Water Board) issued a water quality certification for the Lower Klamath Project License Surrender (Federal Energy Regulatory Commission Project No. 14803). The Executive Director also certified the Final Environmental Impact Report for the Lower Klamath Project License Surrender (Final EIR).

The Lower Klamath Project License Surrender is located on the Klamath River in Klamath County, Oregon and Siskiyou County, California. The project involves the removal of four dams (J.C. Boyle, Copco No. 1, Copco No. 2, and Iron Gate) and associated facilities.

The water quality certification and additional information, including the Final EIR and frequently asked questions, are available on the State Water Board's Project webpage.
For info: SWRCB webpage at: www.waterboards.ca.gov/waterrights/ >> Search for "Lower Klamath Project"

CLEANUP WA

BROWNFIELDS CLEANUP GRANTS

EPA has announced that four communities and tribes in the State of Washington will receive a total of $1.8 million to assess and clean up contaminated properties under EPA's Brownfields Program.

A Brownfield is a property for which the expansion, redevelopment, or reuse may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant. There are estimated to be more than 450,000 brownfields in the United States. EPA's Brownfields Program began in 1995 and has provided nearly $1.6 billion in brownfield grants to assess and clean up contaminated properties and return blighted properties to productive reuse. To date, brownfield investments have leveraged more than $31 billion in cleanup and redevelopment and created more than 160,000 jobs.

EPA's Brownfields Program provides communities across the country an opportunity to transform contaminated sites into community assets that attract jobs and achieve broader economic development outcomes, while taking advantage of existing infrastructure.

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Nationwide, 151 state & tribal communities are selected to receive grant awards totaling over $65.6 million in EPA brownfields funding through the agency's Assessment, Revolving Loan Fund, and Cleanup Grant Programs.

In addition to environmental and health and safety benefits, brownfield grants have been shown to substantially increase local tax revenue. A study of 48 brownfield sites found that an estimated $29 million to $97 million in additional local tax revenue was generated in a single year after cleanup. This is two to seven times more than the $12.4 million EPA contributed to the cleanup of these sites. Cleanup also increases residential property values. Another study found that property values of homes near revitalized brownfields sites increased between 5 and 15 percent following cleanup.

In Washington, four projects have been selected to move forward:

Grays Harbor Council of Governments, Grays Harbor County, WA - Assessment Grant - $600,000

Community-wide grant funds will be used to conduct about 12 Phase I and nine Phase II environmental site assessments. Grant funds also will be used to: inventory and prioritize sites; develop five cleanup plans; one site reuse plan; two area-wide plans; and support community outreach activities. Assessment activities will focus on the cities of Aberdeen and Hoquiam, which are located in Qualified Opportunity Zones, as well as the cities of Cosmopolis, Westport, and Elma, all of which represent the historically industrial and commercial centers of Grays Harbor County and are project coalition partners.

Port Gamble S'Klallam Tribe, WA - Assessment Grant - $300,000

Community-wide grant funds will be used to conduct up to five Phase I and up to five Phase II environmental site assessments. Grant funds also will be used to: enhance and maintain a brownfields inventory; develop four cleanup plans; and support community outreach activities. Assessment activities will focus on sites within the Port Gamble S'Klallam Indian Reservation. Priority sites include the Point Julia historic tribal village, The Bars beach area, a shooting range, and multiple dump sites.

Port of Chelan County, WA - Assessment Grant - $600,000

Community-wide grant funds will be used to conduct ten Phase I and five Phase II environmental site assessments. Grant funds also will be used to: inventory brownfield sites; prepare cleanup plans for four sites; and support community outreach activities. Assessment activities will focus on the neighborhoods of Downton Wenatchee and South Wenatchee, the City of Rock Island, and the unincorporated community of Malaga, all of which are located in Qualified Opportunity Zones. Target sites include: a 300,000 square-foot former cold storage warehouse; the Public Utility District Operations Center; an agricultural chemical facility; the Mission Street Corridor; a former silicon smelter; and a former orchard. Coalition partners are the Port of Douglas County, the City of Wenatchee, and the City of Rock Island.

City of Vancouver, WA -Assessment Grant - $600,000

Community-wide grant funds will be used to conduct at least ten Phase I and eight Phase II environmental site assessments. Grant funds also will be used to: update and expand a brownfield site inventory; prepare two cleanup plans; develop up to two area-wide plans; and conduct community outreach activities. Assessment activities will focus on the Fourth Plain Boulevard Corridor, which includes three Qualified Opportunity Zones. Priority sites include: a former radiator shop; a public-works operations center; a former mechanic shop; and a former dry cleaner/office park. The City's coalition partners are Clark County Public Health and the Vancouver Housing Authority. Grants awarded by EPA's

For info: Mark MacIntyre, EPA, 206/553-7302 or macintyre.mark@epa.gov; EPA brownfields grants website: www.epa.gov/brownfields/types-brownfields-grant-funding; List of the FY 2020 applicants selected for funding: https://go.usa.gov/xvwjc

AQUIFER RECHARGE — ID

ESPA & TREASURE VALLEY EFFORTS

The State of Idaho has made significant strides toward meeting the annual target of recharging an average of 250,000 acre-feet of water into the Eastern Snake Plain Aquifer (ESPA) on an ongoing basis. The State has met or exceeded that goal in the last three winters.

Last December, the Idaho Water Resource Board (IWRB) released a ten-year progress report on ESPA recovery and sustainability efforts. The reeport includes information about IWRB's recharge program and initiatives by groundwater users and other stakeholders. As a result of these initiatives, the volume of the ESPA has increased by about 1.8 million acre-feet, based on measurements of 300-plus ground water monitoring wells in 2019. The progress report documents increased groundwater levels are a result of the combined efforts of the state and the water users, including 5-6 years of capacity-buildout of IWRB's recharge program and ongoing funding support from the Idaho Legislature. Significant initiatives from the historic water settlement between Snake River surface water users and groundwater users have resulted in a 13 percent reduction in groundwater use across the ESPA or 240,000 acre-feet of water per year. Build-out of a comprehensive cloud-seeding program supported by Idaho Power Company, the Board, and the water users as well as a robust snowpack and streamflow runoff over the past several years also contributed to improved conditions in the ESPA.

Under IWRB's water rights for ESPA recharge, it is diverting about 670 **c**ubic **f**eet per **s**econd (cfs) in the Magic Valley region to recharge the aquifer. IWRB has about 1,000 cfs of capacity in the region, but the US Bureau of Reclamation is holding back additional water flows in upstream reservoirs until it has a better sense of how much water will be released for flood control.

In other action, IWRB received a preliminary report from consultant Brown and Caldwell about the potential for managed aquifer recharge in the Treasure Valley. The Board commissioned the Treasure Valley

WATER BRIEFS

Managed Recharge Feasibility Study to seek additional ways to prepare for rapid population growth and future water demand in the Treasure Valley. The population in the Treasure Valley is expected to increase to 1.5 million by 2065. Future demand for Domestic, Commercial, Municipal and Industrial water uses is expected to increase by about 158,000 acre-feet over that time period.

The study included analysis of available water supply for recharge from the Boise, Payette, and Snake Rivers. Brown and Caldwell representatives concluded that surplus water is available during spring runoff for aquifer recharge. An average of 1.1 million acre-feet of surplus surface water leaves the Boise River Basin in the spring during high water flows. A portion of that water could be recharged into Treasure Valley aquifers. The study also documented areas across the Treasure Valley that are physically conducive or not conducive for recharging water into the aquifer. Brown and Caldwell representatives said this information can be used by water managers to select potential recharge locations and identify options for diverting surplus water from the river to recharge sites via injection well or infiltration basin.

In 2016, IWRB commissioned a five-year project to develop a Treasure Valley Ground Water Flow Model in partnership with the US Geological Survey. The purpose of that project is to learn more detail about the Treasure Valley shallow and deep aquifers and how ground water flows beneath the valley. Results from the Treasure Valley Ground Water Flow Model will be used to update the findings of the recharge study to help IWRB and other water user entities determine whether recharge is an option to address specific water management issues in the Treasure Valley.

For info: Brian Patton, IWRB, 208/ 287-4800; Treasure Valley aquifer studies website: https://idwr.idaho.gov/water-data/projects/treasure-valley/.

"BUG FLOW" SW

MACROINVERTEBRATE PRODUCTION FLOW

From May 1st through August 31st, the US Bureau of Reclamation (Reclamation) will conduct a Macroinvertebrate Production Flow at Glen Canyon Dam. This experiment, also known as a Bug Flow, aims to improve egg-laying conditions for aquatic insects, which are the primary food source for endangered and native fish in the Colorado River. This is the third consecutive year for the Bug Flow under the Glen Canyon Dam Long-Term Experimental and Management Plan.

During the Bug Flow experiment, Reclamation will make targeted adjustments to water releases from Glen Canyon Dam and Lake Powell. That adjusted release schedule will include low and steady flows during weekends, while weekday operations will maintain normal flows to meet hydropower demands. Weekday release rate hourly changes will remain unchanged.

Aquatic insects lay and cement their eggs to rocks, vegetation and other materials near the river's edge. If flows are too variable, water levels may drop below where eggs are laid, causing them to dry out and die.

"Findings indicate that some aquatic insects are already benefiting from the bug flows, which also benefits fish and other animals that eat them," said Scott VanderKooi, chief of the US Geological Survey's Grand Canyon Monitoring and Research Center. "For example, our research suggests that caddisflies, an extremely rare aquatic insect in the Grand Canyon over the past several decades, increased nearly four-fold during the first year of the experiment in 2018, before returning to pre-Bug Flows numbers in 2019. In contrast, non-biting midges, another type of aquatic insect that is a key food source for fish and other wildlife, may have increased, and a third year of Bug Flows should help verify this finding."

Recreational fishing at Lees Ferry also improved during Bug Flows, with anglers catching an average of 1-2 more rainbow trout per day during Bug Flow weekends, when flows were low and steady, compared to weekdays when flows fluctuated.

"Our current experimental plan initially recommended two to three years of Bug Flows given the complexity of the Colorado River ecosystem, which is constantly changing," said Lee Traynham, Reclamation's Glen Canyon Dam Adaptive Management Program Manager. "We've already learned a lot about the ecosystem and have observed several resource improvements over many years of experimenting with flows. We are excited to see how the ecosystem responds this year."

The decision to conduct this experiment was based on technical input and recommendation from a collaborative team of scientists and technical experts from federal agencies and states involved in the Glen Canyon Dam Adaptive Management Program. This team includes representatives from: Reclamation; National Park Service; US Geological Survey; US Fish and Wildlife Service; and Bureau of Indian Affairs; the US Department of Energy's Western Area Power Administration; Arizona Game and Fish Department; Upper Colorado River Commission; and all seven Colorado River Basin States.

Experiments are designed to maximize benefits to the Colorado River ecosystem through the Grand Canyon, while meeting water delivery requirements and minimizing negative impacts to hydropower production. This experiment is expected to benefit aquatic insects and the fish, birds and bats that feed on them, while providing valuable scientific information for future decision making.

For info: Robyn Gerstenslager, Reclamation, 801/ 524-3720 orrgerstenslager@usbr.gov; Glen Canyon Dam Adaptive Management Program: www.usbr.gov/uc/progact/amp/index.html; Science Behind the Bug Flows: https://pubs.er.usgs.gov/publication/70170803

CO RIVER OPERATIONS SW

RECLAMATION PROJECTIONS

Reclamation has released its April 24 Month Study, which projects Colorado River operations for the next two years. The Study projects the operating conditions of the Colorado

River system, as well as runoff and reservoir conditions. The Upper Basin experienced around average snowpack (107%) this year, and the April-July inflow into Lake Powell is expected to be 78% of average. The below-average projection is due to extremely dry conditions in the basin during October and November of 2019. Consistent with the 2007 Interim Guidelines, Lake Powell will operate under an annual release of 8.23 million acre feet in water year 2020.

The April 24 Month Study projects Lake Mead's January 1, 2021 elevation to be 1084.69 feet, putting Lake Mead in a Tier Zero condition for 2021. The Study also projects a Tier Zero condition for Lake Mead in 2022 with the projected January 1, 2022 elevation of 1084.39 feet. Tier Zero conditions require a 192,000 acre-foot reduction in Arizona's 2.8 million acre-foot allocation. The Lower Colorado River Basin is in Tier Zero for 2020. The April 24 month study projects that the Lower Colorado River Basin will remain in the Tier Zero condition in 2021.

These reductions will fall entirely on Central Arizona Project (CAP) supplies, impacting CAP supplies for water banking, replenishment and agricultural users. The Tier Zero reductions will not impact tribal or municipal CAP water users.

While the Tier Zero reductions are significant, they are part of broader efforts being implemented to reduce the near-term risks of deeper reductions to Arizona's Colorado River supplies. In addition to the Tier Zero reductions to CAP supplies, other programs to conserve and store water are being implemented in Arizona. These include programs with the Colorado River Indian Tribes, Gila River Indian Community, Fort McDowell Yavapai Nation, Metro Water District, Mohave Valley Irrigation and Drainage District, the Arizona Department of Water Resources (ADWR), Central Arizona Water Conservation District (CAWCD), as well as Reclamation.

The April 24 Month Study shows that in the near term, the programs being implemented in Arizona and across the Colorado River system, along with favorable hydrology, have helped avoid a near-term crisis in the Colorado River system. However, there continue to be significant near-term and long-term risks to Arizona's Colorado River supplies. ADWR and CAWCD intend to jointly convene Arizona water stakeholders to address these risks and to prepare for new negotiations regarding the long-term operating rules on the Colorado River later this year.

For info: Shauna Evans, ADWR, 602/771-8079 or smevans@azwater.gov; Reclamation April 24-Month Study at: www.usbr.gov/lc/region/g4000/24mo.pdf

GROUNDWATER LEVELS NE REPORT FINDS REBOUND

Groundwater levels across much of Nebraska continue to rebound from the historic 2012 drought, according to a 2019 Groundwater-Level Monitoring Report. However, the groundwater-level rises resulting from the historic flooding of 2019 have not yet been completely accounted for. While the flooding had a grave impact on surface water levels throughout much of Nebraska, how it affects the groundwater supply will be measured in the coming years, according to Aaron Young, a geologist with the University of Nebraska–Lincoln's School of Natural Resources.

The reasons for the information delay, Young said, are threefold. Groundwater levels for the annual report are collected each spring, so data from some of the 5,000-plus wells measured throughout the state were collected prior to the mid-March floods. Also, the floodwaters take time to seep into the state's vast groundwater supply. In other cases, wells that would typically be examined for the annual report could not be accessed, as they were completely submerged.

"I personally measure about 125 wells out of about 5,000," Young said. "Last year, there were six that I attempted to measure where, as you were driving up to it, you could look down the road and it was just water. You couldn't even see the wells sticking out of the ground. The flooded areas may have been underrepresented in this year's report. This year, several hundred wells that we normally measure, particularly in Kearney County, around Fremont and some other hard-hit areas, didn't get measured."

Some pockets of the state, predominantly in southwestern Nebraska and the Panhandle, saw minor groundwater level declines. But a map in the latest Groundwater-Level Monitoring Report that shows the changes in groundwater supply from spring 2018 to spring 2019 is mostly bathed in hues of green and blue, indicating a wealth of increases in groundwater across the rest of Nebraska. On average, wells measured in spring 2019 saw a 2.63-foot increase in groundwater levels statewide. "That's a pretty significant rise," Young said. "In many areas of the state, it doesn't completely offset, but it helps to offset, some of the declines we had from the drought in 2012 that are still lingering in many areas."

Young said there are some areas of the state that likely will not fully recover from the 2012 drought for an extended period of time, but one of the counties hit hardest by it had some of the biggest gains in groundwater last year. Colfax County had about a 15-foot rise in groundwater levels this year, Young said, after about a 20- to 25-foot decline during the drought. The county, located about 75 miles west of Omaha, does not have a large irrigated-agricultural footprint compared to other rural Nebraska counties, so its residents most often experienced the lack of groundwater at personal levels. Due to the drought, many house wells there went dry.

Data used to compile the annual Groundwater-Level Monitoring Report are collected by 30 different state and local agencies, and Young leads a University of Nebraska–Lincoln effort to process the data, plot it and then hand draw maps that are published in the report.

For info: Report at: http://snr.unl.edu/data/water/groundwater/gwlevelchangemaps.aspx.

CALENDAR

May 18-20 CA
WSWC-CDWR 2020 Sub-Seasonal to Seasonal Precipitation Forecasting Workshop, San Diego. DoubleTree by Hilton San Diego Downtown, 1646 Front Street. Presented by the Western States Water Council. For info: www.westernstateswater.org/upcoming-meetings/

May 20 WEB
Applying for a WIFIA Loan Webinar, 2:00 - 3:30 pm ET. Presented by EPA. For info: www.epa.gov/wifia

May 21 MT
Conservation Easements Seminar, Bozeman. Best Western Grantree Inn, 1325 N. 7th Avenue. For info: The Seminar Group, 800/ 574-4852, info@theseminargroup.net or www.theseminargroup.net

May 27-28 NM
The Second Colorado River Basin Data and Modeling Roundtable Meeting, Albuquerque. Sheraton Albuquerque Airport Hotel. Hosted by the Western States Water Council. For info: www.westernstateswater.org/upcoming-meetings/

May 28-29 ID
NGWA Workshop on Groundwater in the Northwest, Boise. Boise Watershed Center, 11818 West Joplin Road. Presented by National Groundwater Assoc. For info: www.ngwa.org/detail/event/2020/05/28/default-calendar/20may5043

May 29 CA
CEQA and the NEPA Re-Write Seminar, San Diego. Latham & Watkins Conference Center. For info: Law Seminars International, 206/ 567-4490, registrar@lawseminars.com or www.lawseminars.com

June 3-5 China
Aquatech China - 13th Edition Trade Show, Shanghai. National Exhibition & Convention Center. For info: Annelie Koomen, 31 (0)20-549 3019 or a.koomen@rai.nl

June 4-5 AZ
Seventh Annual Tribal Water in the Southwest Conference, Scottsdale. We-Ko-Pa Resort & Conference Center. For info: www.lawseminars.com/seminars/2020/20TRIBWAZ.php

June 4-6 India
World Environment Expo 2020 - International Exhibition, Conference & Awards, New Delhi. Pragati Maidan. Concurrent with World Environment Conference (WEC 20). For info: http://worldenvironment.in/

June 9 CO
RESCHEDULED TO SEPT. 15TH -- Riverbank 2020, Denver. Denver Botanic Gardens. Fundraiser for Colorado Water Trust. For info: http://coloradowatertrust.org/riverbank-2020?mc_cid=edac123877&mc_eid=54a069fd94

June 11-12 OR
The Mighty Columbia Conference, Portland. World Trade Center, 121 SW Salmon Street. For info: The Seminar Group, 800/ 574-4852, info@theseminargroup.net or www.theseminargroup.net

June 14-17 CA
ACE20 Conference: Global Water Experts in Every Segment of the Water Industry, Orlando. Orange County Convention Center. Presented by American Water Works Assoc. For info: www.awwa.org/Events-Education/Events-Calendar

June 15-16 CO
Green Infrastructure Course, Denver. EUCI Conference Center. Concepts, Planning & Implementation. For info: www.euci.com/events/

June 16 WEB
Effective Utility Management (EUM) Roadmap Webinar: Taking the Next Step Toward Sustainability, Presented by EPA; 1:00 pm - 3:00 pm EDT. For info: https://rossstrategic.zoom.us/webinar/register/WN_D8JptFC6SdOqjFDd95uxzg

June 18 WA
Celebrate Waters Event, Seattle. Ivars Salmon House. Presented by the Center for Environmental Law & Policy. For info: www.celp.org

June 18-19 MI
PFAS Litigation in the Midwest Seminar, Detroit. Southfield Town Center. For info: Law Seminars International, 206/ 567-4490, registrar@lawseminars.com or www.lawseminars.com

June 22-23 WA
Tribal Consultations Seminar, Seattle. 901 Fifth Avenue Building. RE: Conducting Projects Effecting Tribal Lands. For info: www.LawSeminars.com

June 22-23 ND
Bakken Oil & Gas Shale Water Management 2020: Cost-Effective Water Strategies for North Dakota Exhibition & Conference, Williston. TBD. For info: www.bakken.shale-water-management.com/?join=VR

June 25-26 WA
Water Law in Washington Seminar, Seattle. Westin Seattle Hotel. For info: Law Seminars International, 206/ 567-4490, registrar@lawseminars.com or www.lawseminars.com

June 28-July 2 ND
Western Governors' Association 2020 Annual Meeting, Medora. TBA. For info: https://westgov.org/

June 29-30 CA
California Water Boards Water Data Science Symposium, Sacramento. CalEPA Headquarters. For info: www.waterboards.ca.gov/resources/data_databases

Note: *Events are being rescheduled, canceled, or adapted online due to coronavirus. Check with event organizers.*

The Water Report
Water Rights, Water Quality & Water Solutions in the West
260 N. Polk Street • Eugene, OR 97402

CALENDAR

(continued from previous page)

July 13-16 TX
Texas Water 2020: Exhibition & Conference, Fort Worth. Fort Worth Convention Center. For info: www.txwater.org

July 14 ID
Water Law for Utilities - Idaho Rural Water Assoc. Class, Twin Falls. Twin Falls County Clerk: Annex Conference Room, 630 Addison Avenue W, Ste. 103; 8:30 am - 4:30 pm. For info: www.idahoruralwater.com/Training/Training/TabId/5524/PgrID/17727/PageID/3/Default.aspx

July 15 ID
Water Law for Utilities - Idaho Rural Water Assoc. Class, Pocatello. Police Station EOC Training Room, 5205 S. 5th Street, 8:30 am - 4:30 pm. For info: www.idahoruralwater.com/Training/Training/TabId/5524/PgrID/17727/PageID/3/Default.aspx

July 17 ID
Water Law for Utilities - Idaho Rural Water Assoc. Class, Fruitland. Fruitland Treatment Plant, 1200 NW 6th Avenue. For info: www.idahoruralwater.com/Training/Training/TabId/5524/PgrID/17727/PageID/3/Default.aspx

July 22-24 WY
Western States Water Council 2020 (193rd) Meeting, Cody. Holiday Inn / Buffalo Bill Village Resort. Presented by the Western States Water Council. For info: http://www.westernstateswater.org/upcoming-meetings/

July 23-24 OR and WEB
3rd Annual Agriculture Law Seminar, Bend. McMenamin's Old St. Francis School. Avilable via Live Webcast. For info: The Seminar Group, 800/ 574-4852, info@theseminargroup.net or www.theseminargroup.net

July 23-25 UT
66th Annual Rocky Mountain Mineral Law Institute, Salt Lake City. The Grand America Hotel. For info: www.rmmlf.org/conferences

August 11-12 OR & WEB
Shoreline Development & Permitting Seminar, Seaside. Seaside Civic & Convention Center, 415 First Avenue. For info: The Seminar Group, 800/ 574-4852, info@theseminargroup.net or www.theseminargroup.net

August 17-18 Alberda
5th Annual Canadian Frac-Sand Exhibition & Conference, Calgary. For info: www.canada.frac-sand-conference.com