Tenacious Drought and Forever Chemicals in the Colorado River Basin

*Scarlett Forrest**

The Colorado River Basin is in a precarious state. A persistent drought, referred to by scientists as a megadrought, has plagued the precious water resource for decades with no end in sight. To make matters worse, a family of human-made toxic chemicals is polluting the basin. Although toxic, these "forever" chemicals have useful properties that make them a favorite in everything from firefighting foam to nonstick pans. However, the same properties that made these chemicals useful can also make them harmful. The basin is under unrelenting pressure from both the megadrought and these persistent contaminants. As such, the situation warrants proactive intervention, and basin states should galvanize and develop a protocol to protect their shared resource. An effective plan imagines a cooperative federalism structure with authority vested in basin leadership to nimbly respond to the evolving situation. Furthermore, the protocol's design should have governance and implementation measures that pragmatically incorporate the legal and scientific realities of PFAS contamination. Specifically, the governance structure suggestions derive from the basin's own existing water quality program for salinity. For implementation, assessment recommendations are provided to prioritize identifying those most at-risk of high exposure.

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I. INTRODUCTION

I first heard murmurs about forever chemicals when I was an environmental scientist in North Carolina. News broke that a factory dumped these "forever" chemicals, also known as PFAS, in North Carolina's Cape Fear River over decades. The reality of the situation sank in when my friend told me her mother bought a home downstream from this factory. Suddenly, bottled water lined her mother's counters. Long pauses were taken before taps were turned on: Could she use the water to boil pasta? Wash her hands? Brush her teeth? Her mother considered moving, but the value of her home had plummeted, trapping her in a house haunted by chemicals in her water that promised to be there "forever."

Years later, I moved to the Rockies to pursue law school. While visiting Frisco, Colorado, a different friend handed me a notice she received about her water and asked whether she should be concerned. I was shocked to see PFAS were detected in Dillon Reservoir. Factories like the one in North Carolina do not exist in this tiny ski town. So, how had this happened?

Discussion of Colorado River Basin water appears frequently in the news cycle. Typically, the news focuses on water quantity in the basin as the megadrought continues to threaten water supplies. PFAS contamination poses further complications to the river system's remaining water. Given the severe impacts PFAS have on human health and the increased pressure PFAS apply on an already strained river system, PFAS contamination should be comprehensively assessed

in the basin. This paper calls on the basin leadership to develop a protocol and equitably share the burden of PFAS contamination under these extraordinary circumstances. Part II describes PFAS science and provides context to the harmful effects of PFAS contamination. Part III explains the reasoning for the development of basin states' own protocol. Part IV suggests ideas for the governance and implementation of a protocol in the basin.

II. FOREVER CHEMICALS: AN OVERVIEW

"Forever chemicals" is the colloquial name for PFAS: per- and polyfluoroalkyl substances.[1] When news entities or government agencies discuss PFAS, they use "PFAS" as an umbrella term to describe an entire family of chemicals with a similar chemical structure.[2] The PFAS family is large and could encompass 5,000-10,000 individual chemical substances.[3] DuPont discovered the first member of this chemical family in 1938 while conducting experiments for refrigerants.[4] By the 1950s, PFAS were commonly used in products and manufacturing.[5] These products were ubiquitous in many industries, including aviation, automotive, medicine, construction, and electronics.[6] Additionally, PFAS can be found in carpets, clothing, furniture, food packaging, non-stick pans, ski wax, make up, and firefighting foam, among other things.[7] By the 1970s, concerns regarding the impact PFAS have on human health and the environment began to arise.[8] The following subsections explain the PFAS science and their capacity for harm.

A. PFAS Science

Although there is no universally accepted chemical definition of PFAS, they are generally characterized by a unique chemical structure that does not form naturally in the environment.[9] PFAS molecules are typically comprised of a "head" and a "tail."[10] The "head" of the PFAS molecule allows it to bond to things

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1 INTERSTATE TECH. & REGUL. COUNCIL, PER- AND POLYFLUOROALKYL SUBSTANCES TECHNICAL AND REGULATORY GUIDANCE 11 (2022), https://pfas-1.itrcweb.org/wp-content/uploads/2022/09/PFAS-Guidance-Document-9-2022.pdf [hereinafter ITRC PFAS GUIDANCE].

2 *Id.*

3 *Id.* at 13.

4 *Id.*

5 *Id.*

6 *Id.*

7 *Id.* at 13, 49-50.

8 ITRC PFAS GUIDANCE, *supra* note 1, at 13-14.

9 *Id.* at 13-14, 17.

10 *Id.* at 18.

in the environment.[11] As for the tail, its composition makes the PFAS molecule water repellent, stable, and persistent in the environment.[12] There are two PFAS groups of concern: perfluorinated and polyfluorinated.[13] The latter group can break down into the former; yet, the former cannot degrade any further under natural conditions.[14] As such, the "poly" group PFAS that can break down are known as "precursor" PFAS, and the "per" group PFAS are known as "terminal" PFAS.[15]

The unique chemical properties of PFAS make them incredibly useful, and therefore widespread in many different types of products.[16] As mentioned, PFAS are used in firefighting foam, as well as fire-protective clothing, due to their ability to resist high temperatures.[17] Additionally, the chemical makeup of the head and the tail of a PFAS molecule allows it to form films that repel water and oils.[18] These films form "non-stick" coatings on products like Teflon-coated pans and stain-resistant coatings on household items like couches and carpets.[19] While these chemical properties make PFAS so useful in day-to-day items, they are also what make them so toxic and persistent in the environment.[20] However, the full extent of harm that PFAS poses has yet to be determined.

Because PFAS encompass a massive family of chemicals, only a few have been studied for their toxicological impacts on humans and other species.[21] The available data is difficult to characterize due to slight chemical differences between individual PFAS family members causing different health impacts.[22] The

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[11] The "head" gives the PFAS molecule a charge on one end, which is why it can "attract" to things in the environment. *Id.*

[12] The "tail" is a chain of two or more carbon atoms that are bonded to at least one fluorine atom. *Id.*

[13] There is another class of PFAS that are not discussed in this paper, known as polymer PFAS. Polymer PFAS may not have a "head," but still have a carbon chain attached to at least one Fluorine. This class is not discussed because not much is known about those PFAS, and without more information discussion of toxicity, risk assessment, and policy cannot proceed. *See id.* at 19-22.

[14] *Id.* at 18, 24.

[15] "Per" group PFAS have every carbon in their tails bonded with a fluorine and are considered "fully fluorinated." "Per" group PFAS are incredibly stable due to the strength of the carbon-fluorine bond in their tails. "Poly" group PFAS have at least one carbon in their tails bonded with another atom, like hydrogen or oxygen. Those bonds are weaker, which is why they can breakdown. *See id.* at 18, 24, 30.

[16] Env't Bankers Ass'n, *EBA 2023 Virtual Conference, Session 7 Panel: PFAS, The Nitty Gritty,* YOUTUBE (Jan. 26, 2023), https://youtu.be/ce_aXdWeA5s [hereinafter *EBA PFAS Conference*].

[17] *See* ITRC PFAS GUIDANCE, *supra* note 1, at 265.

[18] PFAS molecules chemically attract to interfaces, such as the interface between air and water. This affinity for interfaces is what enables PFAS chemicals to form films that are useful for both specialized and everyday products. *Id.* at 87.

[19] *See id.* at 50, 87.

[20] *EBA PFAS Conference*, *supra* note 16.

[21] *See* ITRC PFAS GUIDANCE, *supra* note 1, at 123.

[22] Individual PFAS are associated with specific health impacts, but the science at this point does not suggest that those health impacts can be extrapolated to all PFAS. *See id* at 123-29.

bulk of the studied PFAS are in the "terminal" group.[23] Still, this information is useful, since "precursor" PFAS can degrade into "terminal" PFAS; however, health impacts from many of the "precursor" PFAS themselves have not been widely studied.[24]

The two most studied "terminal" PFAS family members are PFOA and PFOS.[25] Due to the stability of PFAS molecules, organisms easily absorb them but cannot metabolize them.[26] While humans and other mammals can slowly excrete PFOA and PFOS, their stable chemical structure enables reabsorption of many of the molecules before the body can eliminate them.[27] Therefore, these PFAS can remain in the body for long periods after exposure.[28] Harm to humans is further amplified because PFOA and PFOS can "bioaccumulate."[29] In other words, humans are exposed to a much higher dose internally than a smaller mammal despite exposure to the same dose externally.[30]

Bioaccumulation is not unique to PFAS, but the mechanism by which they do so is novel.[31] PFOA and PFOS bind to proteins, enabling them to attach to the liver, blood serum, and kidneys in humans.[32] Therefore, if a PFAS attaches to blood serum, it can travel throughout the entire body; whereas other pollutants only stick to certain organ systems.[33] PFAS exposure can cause many different harms. Toxicology studies suggest that PFOA and PFOS are linked to increased cholesterol and liver enzymes in blood, decreased vaccination response, asthma, decreased birthweight, thyroid disease, decreased fertility, and pregnancy induced hypertension.[34] PFOA has also been linked to testicular and kidney cancer.[35]

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[23] *See id.* at 123, 356.

[24] Perfluoroalkyl Acids (PFAAs) are the most studied subgroup of "terminal" PFAS, and the two most studied PFAAs are Perfluorooctanoic acid (PFOA) and Perfluorooctane sulfonic acid (PFOS). *See id.* at 123, 358.

[25] *Id.* at 123.

[26] Some PFAA precursors can be metabolized to PFAAS while in the body. *Id.* at 126.

[27] *Id.* at 126, 157.

[28] *See id.* at 126.

[29] "Bioaccumulation" refers to the process where some pollutants can increase in concentration in the tissue of an individual organism over time: the bigger the organism, the higher the concentration. For example, rodents can excrete at least half of the PFAS they were exposed to within several hours to several months, while humans need anywhere from several days to several years. How quickly PFAS can be excreted also depends on the length of the carbon chain of the particular PFAS molecule. *See id.* at 108, 125-26.

[30] *Id.*

[31] Certain PFAS have been shown to "biomagnify" as well, meaning they increase in concentration as they are consumed and transferred up the food chain. *See id.* at 95.

[32] Other pollutants known to bioaccumulate do so by binding to fat; therefore, traditional models used to predict and understand bioaccumulation do not apply. *See id.* at 126.

[33] *Id.* at 124.

[34] *Id*.

[35] *Id.*

Additionally, PFAS family members can each have different impacts.[36]

When there is a PFAS release in the environment, a variety of different outcomes could occur depending upon which PFAS family members are in the release and the amount present.[37] Both the size of a PFAS molecule and the type ("precursor" or "terminal" PFAS) determine the mobility of a PFAS plume, or the speed and size of the chemical footprint as it moves through the environment.[38] A "funnel effect" can occur if the initial release is made up of many "precursor" PFAS and, over time, they degrade into a fewer number of "terminal" PFAS.[39] Additionally, the chemical structure of PFAS allows them to stick to the interface between air and water.[40] This indicates higher PFAS concentrations are more likely found between the land surface down to where the water table fluctuates in the subsurface, also known as the vadose zone.[41] Furthermore, available data show that PFAS can move through air by attaching to particulate matter from a stack emission.[42] PFAS traveling on particulate matter can travel surprising distances in "all wind directions," which is likely responsible for PFAS detections in the Arctic and Antarctic.[43]

B. PFAS Have the Potential to Cause Immense Harm

It is difficult to gauge how concerning PFAS exposure is by just looking at scientific data, given much uncertainty still exists. However, just how PFAS entered the public consciousness gives this data important context. The story begins in 1951, when DuPont, a large chemical manufacturer, bought PFOA from a company called 3M in order to manufacture Teflon.[44] At the time, PFOA was

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[36] *See id.* at 93.

[37] *Id.*

[38] PFAS that have shorter carbon chain "tails" tend to be more water soluble, and therefore travel faster when mixed with groundwater in the environment. The opposite is true for PFAS with longer tails, as they prefer adsorbing to organic carbon and will attach themselves to soil particles. Therefore, longer tail PFAS can get left behind "in the dirt," so to speak, whereas shorter chain PFAS can hitch a ride on water molecules and are mobile in the environment. Other factors in the environment impact PFAS transport as well: pH, mineral make up of soil, presence of other contaminants, etc. *Id.* at 93-95.

[39] Additional factors that contribute to the funnel effect include: the distance from the source, if any remediation has already occurred at the site for other contaminants, and if so, the extent and type of that remediation. *Id.* at 105.

[40] PFAS are attracted to interfaces generally. If there are co-contaminants onsite, the chemical structure of PFAS allows them to stick to the interface between water and the co-contaminant, like petroleum. *See id.* at 100-01.

[41] PFAS that stick to the vadose zone have the potential to continually discharge into the groundwater since they get "stuck" at that interface, and as rain percolates through the ground, it will push the PFAS plume into the groundwater aquifer over time. *See id*.

[42] Preliminary data suggests that some PFAS may also have the potential to volatilize into the air. *Id*. at 102-03.

[43] *Id*.

[44] Nathaniel Rich, *The Lawyer Who Became DuPont's Worst Nightmare*, N.Y. TIMES, (Jan. 6,

not classified as a hazardous substance nor was it on the government's radar, and it would be another 20 years before the Environmental Protection Agency (EPA) existed.[45] Regardless, DuPont received recommendations from 3M to dispose of waste PFOA by incineration or chemical waste disposal, and DuPont's own rules prohibited flushing PFOA into sewers and surface water.[46]

Even still, at DuPont's massive factory in Parkersburg, West Virginia, DuPont dumped PFOA into the Ohio River, stored it in unlined open pits, and emitted it from chimneys for decades.[47] PFOA from the unlined pits and emitted dust seeped into groundwater, contaminating drinking water for over 100,000 people in Parkersburg and surrounding communities.[48]

In the 1980s, DuPont purchased a plot with a running creek in the farmlands of Parkersburg to use as a landfill for factory waste.[49] Soon after DuPont began disposing waste, Wilbur Tennant, the neighbor immediately downstream, noticed something terrible happening to his cows.[50] Tennant, a farmer whose family had deep roots in the area, witnessed his usually docile cows suddenly change disposition and start charging at people.[51] Tennant began documenting this new behavior and recorded a video of an alarmingly thin cow with patches of hair loss and a humpback from a suspected kidney malfunction.[52] Tennant also recorded a dead calf, with one startling, unnatural blue eye.[53] No veterinarian in town would examine Tennant's cows, so when another calf died, he decided to dissect it himself.[54]

The DIY autopsy revealed a disturbing sight: the calf's teeth had turned black, and each organ was alarmingly discolored with swaths of darkened and green tissues.[55] Many of Tennant's cows had deformed hooves, lesions that carved up their hides, and red, sunken eyes.[56] Tennant found two dead deer and two dead cows in the creek he shared with DuPont, blood oozing out of their noses and mouths.[57] By the time Tennant found an attorney to take his case, he had lost a

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2016), https://www.nytimes.com/2016/01/10/magazine/the-lawyer-who-became-duponts-worst-nightmare.html.

45 *Id*.; *The Origins of EPA*, ENV'T. PROT. AGENCY (Last updated June 5, 2023), https://www.epa.gov/history/origins-epa.

46 Rich, *supra* note 44.

47 The DuPont factory in Parkersburg is 35 times the size of the Pentagon. *Id*.

48 *Id*.

49 *Id*.

50 *Id*.

51 *Id*.

52 *Id*.

53 *Id*.

54 The veterinarians allegedly said they "didn't want to get involved." *Id*.

55 DIY stands for do-it-yourself. *Id*.

56 *Id*.

57 *Id*.

total of 153 animals.[58]

Tennant's animals were not the only ones suffering from DuPont's waste. DuPont was a large employer in Parkersburg, and its employees exhibited signs of negative health impacts as well.[59] DuPont workers allegedly coined the term "Teflon flu" to describe when folks would come home from work sick with a fever, nausea, diarrhea, and vomiting.[60] In the 1980s, two of seven pregnant Teflon division employees gave birth to babies with eye defects.[61] At one point, DuPont prohibited PFOA lab chemists from bringing their work clothes home, because DuPont had "found out" PFOA was linked to health problems in women and birth defects in children.[62] One woman, who was married to a PFOA lab chemist, had her second child right before DuPont issued that warning and had to have an emergency hysterectomy six years later and then a second surgery eight years after that.[63] Many people in the Parkersburg community also endured mysterious illnesses or even died from cancer or heart complications.[64]

In 1999, Tennant and his lawyer, Rob Bilott, filed suit.[65] Bilott was tenacious and exposed the dangers of DuPont's chemical practices.[66] The lawsuit kicked off several multimillion dollar settlements holding DuPont contractually obligated to study the health impacts on others in the Parkersburg community not employed by the company.[67] Seven years passed before the study results were released, during which time both Wilbur and his wife were diagnosed with cancer.[68] The study results confirmed "there was a 'probable link' between PFOA and kidney cancer, testicular cancer, thyroid disease, high cholesterol, pre-eclampsia and ulcerative colitis."[69]

Since then, thousands of personal injury lawsuits have been filed against

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58 Apparently, no lawyers in town wanted to get involved either. *Id*.

59 *Id*.

60 *Id*.

61 *Id*.

62 *Id*.

63 *Id*.

64 *Id*.

65 *Id*.

66 DuPont was a classic bad actor. DuPont conducted internal animal studies and studies on their workers for decades and failed to report that PFOA was harmful to the EPA, in violation of the Toxic Substances Control Act (TSCA). The discovery process and lawsuit uncovered that DuPont knew PFOA caused illnesses and cancers, PFOA was present in the local water supply in concentrations that exceeded their own internal safety limit, and even that PFOA was detected in blood banks as far back as 1976. Furthermore, internal documents showed that despite development of less toxic PFOA alternatives, DuPont still chose to continue using PFOA because it was more cost effective. *Id*.

67 DuPont tried to avoid liability by claiming only people who were acutely exposed to PFAS suffered harms, such as their employees or their direct neighbors. *Id*.

68 Tennant had died of a heart attack and his wife died from cancer before the results of the study were released. *Id*.

69 Part of the settlement agreement was that DuPont would not admit causation. *Id*.

DuPont, and DuPont stopped using and producing PFOA in 2013.[70] In 2015, DuPont severed and rebranded its chemical business as Chemours after merging with another company, and is now using replacement PFAS that supposedly biodegrade more quickly.[71] These new PFAS lawfully went into production and use without any oversight or regulation by the EPA.[72] Recently, some of the replacement PFAS have generated public concern and scientific investigation, because they were found to be "precursor" PFAS, although they did biodegrade more quickly as promised.[73] Still, as discussed above, "precursor" PFAS can degrade into "terminal" PFAS, which could result in a stable and persistent PFAS like PFOA.[74] As of June 2022, information about replacement PFAS is still extremely limited since the requisite detection technology is still in development and is not readily available and there are thousands of these chemicals.[75]

III. THE BASIN NEEDS ITS OWN PFAS PROTOCOL

One major challenge PFAS poses to human health and the environment is that everyone has at least trace amounts of PFAS in their blood, including you if you're reading this.[76] Fortunately, there has been progress since Tennant and Bilott kicked the door open with their lawsuit. For one, the EPA has promulgated guidance and proposed regulations. Some states have also begun regulating PFAS. However, the Colorado River Basin is in a unique and precarious position with its own set of problems to address. Between the megadrought, the scope of water users and uses, the numerous allocation agreements, and the basin's

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[70] *Id*.

[71] Chemours is still operating the Parkersburg Factory site, along with 17 other facilities in the U.S. Additionally, Chemours currently has eight facilities in Latin America, eight facilities in Europe, and four facilities in Asia. If one clicks on the Parkersburg Facility on their website, the user is greeted with bold red letters that say: "What we make at Washington Works makes the world work." Washington Works is the name DuPont gave to the Parkersburg factory site. *Id*.; *Global Reach: 58 Worldwide Locations*, CHEMOURS, https://www.chemours.com/en/about-chemours/global-reach; *What we make at Washington Works makes the world work*, CHEMOURS, https://www.chemours.com/en/about-chemours/global-reach/washington-works; DuPont Completes Spin-Off of the Chemours Company, CISION PR NEWSWIRE, July 1, 2015, https://www.prnewswire.com/news-releases/dupont-completes-spin-off-of-the-chemours-company-300107397.html.

[72] Rich, *supra* note 44.

[73] ITRC PFAS GUIDANCE, *supra* note 1, at 24, 42.

[74] *Id*. at 24.

[75] *Id.* at 42, 43.

[76] "Everyone" is meant literally. A 2015 CDC study found four members of the PFAS family in the blood serum of 97 – 100% of Americans. Additionally, the Environmental Working Group (EWG) found detectable levels of PFAS in more than 330 species, spanning across the continents and oceans except for Antarctica and the Southern Ocean. Ryan C. Lewis et al., *Serum Biomarkers of Exposure to Perfluoroalkyl Substances in Relation to Serum Testosterone and Measures of Thyroid Function among Adults and Adolescents from NHANES 2011–2012*, INT. J. ENV'T. RES. & PUB. HEALTH (May 2015); ENV'T WORKING GROUP, *Global danger: Wildlife at risk from PFAS exposure,* https://www.ewg.org/interactive-maps/pfas_in_wildlife/map/.

geology, the river system's resources are claimed and strained in particularized ways. With that context and the risks PFAS pose to human and environmental health, basin leadership should form a PFAS protocol specially tailored to the basin's distinct needs and circumstances.

A. Unprecedented Water Shortages & PFAS Contamination

The basin's (and nation's) largest reservoirs are Lake Powell and Lake Mead, impounded by Glen Canyon and Hoover dams, respectively.[77] In the early 2000s, the basin states and federal government realized persistent drought conditions threatened those reservoirs and the river system as a whole.[78] In response, guidelines for operating the dams were adopted in 2007.[79] Despite changes to the operating regimes, the drought persisted, and both reservoirs' elevations were in danger of reaching critically low levels.[80] Drought contingency plans (DCPs) were implemented in 2019 to supplement the 2007 Guidelines.[81] Even still, in July 2022, the water elevation in Lake Mead dropped to the lowest level recorded since the reservoir's construction.[82] In February 2023, the water elevation in Lake Powell followed suit.[83]

The 2007 Guidelines and 2019 DCPs are both structured around projected water elevations for Lake Mead or Lake Powell on January 1 of each year.[84] When the projections predict certain drops in elevation, water deliveries from the reservoirs are curtailed by a specific amount in a tiered structure.[85] In August 2021, the first water delivery curtailment ever was imposed by the Secretary of the Interior through the Bureau of Reclamation (Reclamation).[86] Arizona received

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77 THE LARGEST RESERVOIRS IN THE UNITED STATES, https://www.worldatlas.com/articles/the-largest-reservoirs-in-the-united-states.html.

78 *Id*.

79 *Id*.

80 *See* Colorado River Drought Contingency Plan Authorization Act, Pub. L. No. 116-14, 133 Stat. 850 (2019).

81 *Id.*

82 Robyn White, *Lake Mead Water Levels Set to Reach All Time Low in 2023*, NEWSWEEK, (Jan. 1, 2023), https://www.newsweek.com/lake-mead-water-levels-reach-all-time-low-2023-1775268#:~:text=Water%20levels%20in%20Lake%20Mead,1%2C040.83%20feet%20in%20March%202023.

83 Alex Hager, *Lake Powell drops to a new record low as feds scramble to prop it up*, NAT'L PUB. RADIO, (Feb. 15, 2023), https://www.kunc.org/news/2023-02-15/lake-powell-drops-to-a-new-record-low-as-feds-scramble-to-prop-it-up.

84 Colorado River Drought Contingency Plan Authorization Act; Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead, Record of Decision (2007) [hereinafter 2007 Interim Guidelines].

85 The projected elevation is based off the estimated water elevation on January 1 of the following year. Lake Mead and Lake Powell have different operating criteria, and the consequences of water elevation dropping to the levels contemplated in the guidelines and plans have different consequences for the applicable basin states. 2007 Interim Guidelines, *supra* note 84.

86 Antone Baltz, *Colorado River Water Rationed for First Time Amid Drought (1)*, BLOOMBERG L., (Aug. 16, 2021), https://news.bloomberglaw.com/environment-and-energy/colorado-river-water-

the brunt; they were told to cut back 18% of their Colorado River water consumption.[87] In response, Arizona turned to groundwater aquifers as a backup source but found a water treatment plant in Tucson had shut down a portion of their groundwater wells the year prior.[88] Why? The wells contained high concentrations of PFAS.[89]

Similarly, in California, the State Water Resources Control Board reported certain utilities are contemplating whether to use known PFAS-contaminated wells to meet demand when faced with shortages.[90] One utility, SCV Water, typically uses a mix of surface and groundwater to meet the demands of their users, and in 2019, found PFAS in a substantial portion of their wells.[91] In 2021, as drought gripped its surface water source, SCV Water had to rely entirely on its groundwater supply.[92] SVC Water stated that if it had to rely on PFAS-contaminated wells to meet demand, it would implement water conservation measures.[93]

The situation for Tucson and SCV Water foreshadows the future predicament facing basin states. The EPA promulgated a final rule beginning in 2023 that requires monitoring twenty-nine PFAS in drinking water.[94] Experience and research show the more drinking water is tested, the more PFAS contamination is found.[95] In addition to monitoring, Reclamation asked the basin states in June 2022 to conserve an unprecedented amount of water to bolster the water levels in Lake Mead and Lake Powell.[96] The writing is on the wall: further water cuts will likely be implemented as the megadrought persists, and suppliers will be forced

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cut-for-first-time-as-drought-grips-west.

87 *Id.*

88 Pat Rizzuto & Bobby Magill, *Drought Exposes 'Canary in This Coal Mine' of PFAS in Well Water*, BLOOMBERG L., (Jan. 31, 2022), https://news.bloomberglaw.com/environment-and-energy/drought-exposes-canary-in-this-coal-mine-of-pfas-in-well-water.

89 *Id.*

90 *Id.*

91 "SCV" stands for Santa Clarita Valley, an area located north of Los Angeles. SCV Water took some preliminary and temporary steps to treat the contaminated groundwater. *Id.*

92 *Id.*

93 *See id.*

94 *Id.*; 40 C.F.R. pt. 141 (2021); Bobby Magill, *Final 'Forever Chemicals' Water Monitoring Rule Issued by EPA*, BLOOMBERG L., (Dec. 20, 2021), https://news.bloomberglaw.com/environment-and-energy/epa-issues-final-forever-chemicals-monitoring-rule.

95 *See generally* ITRC PFAS GUIDANCE, *supra* note 1; Rizzuto & Magill, *supra* note 88;

96 "SEIS" stands for Supplemental Environmental Impact Statement. In June 2022, the Reclamation Commissioner said an additional two-to-four-million acre feet of water needs to be conserved. According to the general manager of the Colorado River District, the basin states collectively use about twelve million acre-feet annually. Meaning the conservation request makes up approximately 17% to 33% of the water consumed annually by the basin states. Marianne Goodland, *Reclamation official tells Colorado River states to conserve up to 4 million acre-feet of water*, COLO. POL., (Dec. 20, 2021), https://www.coloradopolitics.com/energy-and-environment/reclamation-official-tells-colorado-river-states-to-conserve-up-to-4-million-acre-feet-of/article_376a907a-ece6-11ec-b0ba-6b2e72447497.html.

to scrounge for water only to find it riddled with PFAS. The candle is burning at both ends, and the basin states need to extinguish the flame before the candle drips away.

B. The Feds Help Those Who Help Themselves

Admittedly, the basin states could wait for the EPA to promulgate regulations before directly addressing PFAS. However, between the megadrought's constraints on water and the pernicious nature of PFAS contamination, waiting is ill-advised. Furthermore, the federal government likely doesn't have the resources to provide the efficient response the basin needs. As such, those in the basin region are in the best position to make water management decisions because they are personally and directly impacted by strained Colorado River resources.

In addition to the lack of resources, the basin states should not depend on the federal government for PFAS response measures for two more reasons: 1) the federal government has been slow to respond, and 2) the proposed developments are not realistic at this time. That being said, the federal government has stepped up its PFAS response.[97] For instance, Congress passed the Bi-partisan Infrastructure Investment and Jobs Act, which allots $10 billion to address PFAS and other emerging contaminants, and the EPA has proposed enforceable drinking water standards for six PFAS and has proposed PFOA and PFOS hazardous substance designations under CERCLA.[98]

However, the first PFAS rule was proposed in 2005, and since then, no enforceable federal regulation has been established for PFAS released in the environment.[99] Although drinking water standards have been proposed, they are not expected to be finalized until the end of 2023 and could be further delayed in the administrative process.[100] Still, these standards do not apply to private wells, and a basin-state program would fill that gap.[101] In addition to gaps left by the

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[97] *See e.g.*, *Key EPA Actions to Address PFAS*, ENV'T. PROT. AGENCY, https://www.epa.gov/pfas/key-epa-actions-address-pfas (Apr. 21, 2023).

[98] "CERCLA" stands for the Comprehensive Environmental Response, Compensation, and Liability Act. It should also be noted that other government agencies have contributed to PFAS exposure studies, among other things, that are beyond the scope of this paper. 42 U.S.C. § 9601; Press Release, The White House, FACT SHEET: Biden-Harris Administration Combatting PFAS Pollution to Safeguard Clean Drinking Water for All Americans, (June 15, 2022), https://www.whitehouse.gov/briefing-room/statements-releases/2022/06/15/fact-sheet-biden-harris-administration-combatting-pfas-pollution-to-safeguard-clean-drinking-water-for-all-americans/; *Per- and Polyfluoroalkyl Substances (PFAS) Proposed PFAS National Primary Drinking Water Regulation*, ENV'T. PROT. AGENCY, https://www.epa.gov/sdwa/and-polyfluoroalkyl-substances-pfas (Sept. 22, 2023); *Key EPA Actions to Address PFAS*, *supra* note 97.

[99] Some delay is understandable, the science behind PFAS toxicity is fairly new, and toxicity studies can take years to complete. *See* ITRC PFAS GUIDANCE, *supra* note 1, at 143-44.

[100] 40 C.F.R. pt. 141-142 (proposed Mar. 14, 2023).

[101] *Private Drinking Water Wells*, ENV'T. PROT. AGENCY, https://www.epa.gov/privatewells (May 24, 2023).

existing regulatory framework, the EPA has not issued a timeframe for the final CERCLA rule.[102] Due to the uncertain timeframe for those final rules, the basin states should take the initiative and construct their own response to PFAS contamination.

However, even if the EPA does issue final rules, they may not be much help for the basin. The EPA has published unenforceable Health Advisories (HAs) to assist regulators and the public.[103] The issue is, the HAs suggest an incredibly small concentration of PFOA and PFOS in water, a fraction of a part per trillion (ppt), making it impractical to adhere to the advisory.[104] The proposed rules have a slightly more realistic standard of four ppt in drinking water, which is still quite low and likely burdensome to follow and enforce.[105] However, it is understandable how the EPA came to such low numbers. The EPA develops those concentrations by conducting or reviewing animal studies to see at what dose (contaminant concentration) the animal shows a response (negative health effect).[106] The results showed that negative health effects occurred at miniscule concentrations of PFOA and PFOS.[107]

Although true to the animal dose-response, there are several reasons why the HAs are unworkable.[108] First, very few machines in the U.S. can reliably detect PFAS concentrations in the ppt, and those machines cost over $500,000.[109] Second, even if a machine can detect PFAS in the ppt, it's nearly impossible to keep background sources of PFAS from contaminating the samples due to widespread PFAS use.[110] Third, the cost per sample is prohibitive, because those

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102 40 C.F.R. § 302 (proposed Sept. 6, 2022).

103 PFAS Nat'l Primary Drinking Water Reg. Rulemaking, 88 Fed. Reg. 18,638 (proposed Mar. 29, 2023); Press Release, ENV'T PROT. AGENCY, EPA Announces New Drinking Water Health Advisories for PFAS Chemicals, $1 Billion in Bipartisan Infrastructure Law Funding to Strengthen Health Protections (June 15, 2022), https://www.epa.gov/newsreleases/epa-announces-new-drinking-water-health-advisories-pfas-chemicals-1-billion-bipartisan.

104 Most regulations that designate the maximum allowable concentration of a contaminant are measured in parts per billion or parts per million, which are one thousand times larger and one million times larger than a ppt, respectively. *See National Primary Drinking Water Regulations*, ENV'T. PROT. AGENCY, https://www.epa.gov/ground-water-and-drinking-water/national-primary-drinking-water-regulations#one (March 29, 2023). For reference, the EPA's HA is 0.004 ppt. *Drinking Water Health Advisories for PFOA and PFOS*, ENV'T. PROT. AGENCY, https://www.epa.gov/sdwa/drinking-water-health-advisories-pfoa-and-pfos (March 29, 2023)..

105 *Per- and Polyfluoroalkyl Substances (PFAS) Proposed PFAS National Primary Drinking Water Regulation*, ENV'T. PROT. AGENCY, https://www.epa.gov/sdwa/and-polyfluoroalkyl-substances-pfas (Sept. 22, 2023).

106 Interview with Dr. Kang Xia, Professor of Env't. Organic Chemistry, Va. Tech (Mar. 20, 2023) (on file with author).

107 88 Fed. Reg. 18,638.

108 Additionally, PFAS bioaccumulates, meaning it lingers in the human body longer than it does in rodents.

109 Interview with Dr. Xia, *supra* note 106.

110 Background sources can come from the person collecting the sample, or from the lab itself since PFAS is widespread in lab materials. Interview with Dave Hunter, P.G., Regional Technical

laboratories that claim to detect ultra-low concentrations charge hundreds of dollars per sample.[111] Fourth, data have shown PFAS detections are ubiquitous and likely in the ppt (at least) everywhere.[112]

In addition to the HAs being unworkable, they are also unhelpful. The HAs do not distinguish between people and places that face the highest risks of acute PFAS exposure, like those in Parkersburg, from those exposed to "background" concentrations. Therefore, the basin states should develop their own protocol that tests for PFAS at technologically and financially feasible concentrations while also prioritizing the protection of human health and the environment from the highest PFAS concentrations.

C. Patchwork Responses Invite Legal and Logistical Chaos

Large-scale PFAS contamination was detected in North Carolina several years before it was discovered in the Colorado River Basin. Because of this, the status of North Carolina's Cape Fear River contamination provides a glimpse of the potential future for the basin.[113] The Cape Fear River is the sole municipal drinking water source for most people in the region.[114] Chemours has conducted some clean-up, and drinking water plants are updating their facilities to treat PFAS.[115] However, this is an expensive process that will take years to complete.[116] For those on the ground, the process has been chaotic and frustrating.

For instance, a county water supplier wholesales Cape Fear River water to multiple retailers who distribute it to residents and the community.[117] The actions of the retailers have not been consistent. Some have delivered bottled water to folks free of charge, some will deliver bottled water for fees, and some have communicated nothing to their consumers.[118] The latter residents, left in the dark, tried contacting their wholesaler and retailer about the status of their water.[119] Instead of a straightforward answer, the residents were told to go ask the other entity, and after multiple back-and-forth communications, still have no answers.[120] A search of North Carolina's environmental department's website

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Director, Partner Engineering & Sci. (Mar. 10, 2023) (on file with author).

111 Interview with Dr. Xia, *supra* note 106.

112 *Id.*; *see also* ENV'T WORKING GROUP, *Global danger: Wildlife at risk from PFAS exposure* (Sept. 26, 2023), https://www.ewg.org/interactive-maps/pfas_in_wildlife/map/.

113 Interview with Chelsea Halley, Hydrogeologist and North Carolina Resident (Apr. 20, 2023) (on file with author).

114 *Id.*

115 *Id.*

116 *Id.*

117 *Id.*

118 *Id.*

119 *Id.*

120 *Id.*

revealed a link to PFAS sampling results for "transparency."[121] However, clicking the link led to an error page. It is difficult to assign fault for the bureaucratic absurdity, but realistically, current institutions and infrastructure are unprepared for emerging contaminants as damaging as PFAS. This does not bode well for the Colorado River Basin, as the basin's laws, infrastructure, and climate conditions are more complex than those in the Cape Fear River area.

Injured parties in jurisdictions without concrete regulatory guidelines can only recoup the costs associated with PFAS contamination by bringing tort suits against the companies alleged to have contaminated the water.[122] 2016 reporting by Nathaniel Rich with the New York Times on the Parkersburg PFAS contamination stated that 3,535 personal injury plaintiffs had filed cases against DuPont, and estimated that litigation could extend hundreds of years.[123] Putting the current status of PFAS contamination into perspective, an August 2023 study reported that across all 50 states, 3,186 drinking water systems and contaminated sites have detectable PFAS concentrations.[124] Currently, there are only 13 known PFAS manufacturers, and some have business affiliations with each other.[125] The large number of personal injury plaintiffs and PFAS-contaminated locations, compared with the small number of PFAS manufacturers, make it unrealistic for water providers in the basin to attempt to recoup the costs of PFAS contamination via tort litigation.

While waiting for the EPA to issue final rules, many states across the country have initiated their own PFAS regulations.[126] In the basin, California and Colorado have promulgated water-related PFAS regulations, while Arizona, Nevada, New Mexico, Utah, and Wyoming have not.[127] California's regulations require notification and monitoring if PFAS concentrations are found above established limits.[128] Colorado's regulations enable their Water Quality Control Commission to enforce regulatory actions at permitted hazardous waste facilities, but that enforcement is discretionary.[129] The current patchwork approach leaves

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121 A second website check revealed the "transparency" page disappeared altogether. The author, who is quite familiar with the NCDEQ's website, conducted the search, and thus there is nothing to cite to.

122 Rizzuto & Magill, *supra* note 88; *see* ITRC PFAS GUIDANCE, *supra* note 1, at 143, 149.

123 Rich, *supra* note 44.

124 ENVIRONMENTAL WORKING GROUP, *PFAS Contamination in the U.S.* (Aug. 18, 2023), https://www.ewg.org/interactive-maps/pfas_contamination/.

125 EBA PFAS Conference, *supra* note 16.

126 ITRC PFAS GUIDANCE, *supra* note 1, at 149.

127 Please note, Nevada and New Mexico have promulgated their own guidance, but the guidance is not enforceable at this time. ITRC PFAS GUIDANCE, *supra* note 1, at https://pfas-1.itrcweb.org/wp-content/uploads/2023/02/ITRCPFASWaterandSoilValuesTables_JAN2023-Final.xlsx.

128 ITRC PFAS GUIDANCE, *supra* note 1, at https://pfas-1.itrcweb.org/wp-content/uploads/2022/11/ITRCPFAS_Regulatory_Programs_Table_OCT2022-FINAL.xlsx.

129 Policy 20-1, Colo. Water Quality Control Commission, Dep't of Pub. Health & Env't 1, 12-13 (July 14, 2020), https://drive.google.com/file/d/119FjO4GZVaJtw7YFvFqs9pmlwDhDO

basin states without any teeth to enforce cleanup actions. As such, the basin should not sit back and wait for EPA guidance or their own states to form PFAS regulations piece by piece. A cohesive, basin-wide plan is necessary to mitigate the risks of PFAS to human health and the environment.

IV. THE PFAS PROTOCOL

PFAS provide numerous unprecedented challenges to both the scientific and legal fields. Due to PFAS' uniquely detrimental chemical properties and the many unknowns surrounding PFAS, extending the current regulatory frameworks to PFAS contamination could inadequately protect human health and the environment. The following recommendations modify existing water quality and contamination legal frameworks to better meet the challenges PFAS present.

Environmental Justice Considerations

Addressing PFAS decades after their widespread use and release into the environment offers the opportunity to apply lessons from past environmental disasters and respond more effectively. Developing a PFAS protocol for the basin presents a chance to assess and combat the contamination in an environmentally just way, and basin states must rise to the occasion. The PFAS protocol should consider several crucial aspects of environmental justice. First, the common denominator between the present-day Chemours facilities in North Carolina and Parkersburg, West Virginia is their locations in low-income areas.[130] In fact, several Chemours production facilities are located in areas where the median household income falls in the bottom thirtieth percentile in the U.S.[131] Second, PFAS contamination disproportionally impacts the drinking water available to communities of color.[132] An effective PFAS protocol must address racial and income disparities of PFAS exposure.

Third, the historical absence of tribal representation has plagued water

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[130] *See* Household Income in White Oak, NC, Best Neighborhood, https://bestneighborhood.org/household-income-white-oak-nc/#samecitylinks (accessed Sept. 29, 2022; *see* Household Income in Parkersburg, WV, Best Neighborhood, https://bestneighborhood.org/household-income-parkersburg-wv/#samecitylinks (accessed Sept. 29, 2022).

[131] *See id*.; *see also* Household Income in 40216, KY, Best Neighborhood, https://bestneighborhood.org/household-income-40216/ (accessed Sept. 29, 2022); Household Income in Eldorado, AR, Best Neighborhood, https://bestneighborhood.org/household-income-el-dorado-ar/ (accessed Sept. 29, 2022); Household Income in Jesup, GA, Best Neighborhood, https://bestneighborhood.org/household-income-jesup-ga/ (accessed Sept. 29, 2022); *Global Reach: North American Offices*, *Production Facilities, and R&D Facilities*, CHEMOURS, https://www.chemours.com/en/about-chemours/global-reach.

[132] Press Release, Harvard Sch. of Pub.Health, Communities of color disproportionately exposed to PFAS pollution in drinking water (May 15, 2023), https://www.hsph.harvard.edu/news/press-releases/communities-of-color-disproportionately-exposed-to-pfas-pollution-in-drinking-water/; *see also* Nat'l Acads. of Sciences, Engineering, and Medicine; *Guidance on PFAS Exposure, Testing, and Clinical Follow-Up* (2022).

management decisions in the Colorado River Basin.[133] Thirty federally recognized tribes live within the basin, but only twenty-two tribes have recognized, quantified water rights.[134] The major intranational instruments governing Colorado River Basin Water allocation, namely the 1922 Colorado River Compact, the 1948 Upper Basin Compact, and the Arizona v. California decree, reference tribal water rights ambiguously.[135] Thus, these apportionments have prevented water rights on paper from developing into usable "wet" rights.[136] Moreover, these allocation frameworks were developed without tribal consultation or representation.[137] Given that PFAS poses a water quality challenge in an area already grappling with water quantity issues, it is imperative to address the longstanding gap created by the absence of tribal involvement. The following sections will detail potential approaches to include tribes in the governance and implementation of the PFAS protocol.

A. Governance Lessons from Salinity Control

1. Overview of the International Boundary and Water Commission

A PFAS protocol would not be the first water quality program specifically created for the basin. Salinity has caused consistent water quality problems.[138] In 1961, a U.S. irrigation district discharged highly saline wastewater into the Colorado River just north of the U.S.-Mexico border.[139] The discharge caused extensive damage to Mexico's agricultural fields, sparking salinity control

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133 *See* Michael Elizabeth Sakas, *Historically Excluded from Colorado River Policy, Tribes Want a Say in How the Dwindling Resource is Used. Access to Clean Water is a Start.*, COLORADO PUBLIC RADIO, (Dec. 7, 2021), https://www.cpr.org/2021/12/07/tribes-historically-excluded-colorado-river-policy-use-want-say-clean-water-access/.

134 The federally recognized tribes include: Ak-Chin Indian Community, Chemehuevi Indian Tribe, Cocopah Indian Tribe, Colorado River Indian Tribes, Fort McDowell Yavapai Nation, Fort Mojave Indian Tribe, Gila River Indian Community, Havasupai Tribe, Hopi Tribe, Hualapai Indian Tribe, Jicarilla Apache Nation, Kaibab Band of Paiute Indians, Las Vegas Tribe of Paiute Indians, Moapa Band of Paiute Indians, White Mountain Apache, Navajo Nation, Pascua Yaqui Tribe, Quechan Indian Tribe, Salt River Pima-Maricopa Indian Community, San Carlos Apache Tribe, San Juan Southern Paiute Tribe, Shivwits Band of Paiute Indian Tribe of Utah (Constituent Band of the Paiute Indian Tribe of Utah), Southern Ute Indian Tribe, Tohono O'odham Nation, Tonto Apache Tribe, Ute Indian Tribe, Ute Mountain Ute, Yavapai-Apache Nation, Yavapai- Prescott Indian Tribe, and Pueblo of Zuni. The PFAS protocol would ideally include an avenue for participation by unrecognized tribes, too. Water & Tribes Initiative, *The Status of Tribal Water Rights in the Colorado River Basin* (April 9, 2021), http://naturalresourcespolicy.org/publications/policy-brief-4-final-4.9.21-.pdf.

135 *See* Colorado River Compact, art. 7, 45 Stat. 1064 (1928); Upper Colorado River Basin Compact, art. 17, 63 Stat. 31 (1949); Arizona v. California, 373 U.S. 546, 598-602 (1963).

136 *See generally* Water & Tribes Initiative, *supra* note 134.

137 *Id*.

138 *See generally* Colorado River Basin Salinity Control Act, 43 U.S.C. §§ 1571-1599 (1974).

139 Salinity is the measure of salt content in water. Lawrence J. MacDonnell, *Colorado River Basin*, *in* WATERS AND WATER RIGHTS 36-37 (2021).

developments.[140] To avoid international controversy, the U.S. and Mexico agreed to changes to the minute system in their 1944 treaty governing international apportionment of the Colorado River.[141]

The minute system functions as a dispute resolution method to address novel issues not specifically covered in the treaty.[142] Minutes add treaty implementation provisions that carry the force and effect of law.[143] Minutes are added by the International Boundary and Water Commission (IBWC), a governance body made up of a U.S. and a Mexico section.[144] Each section is led by a commissioner with engineering experience, and each commissioner is supported by associated staff.[145] When the IBWC adds a minute, both commissioners have to sign it, and then copies are sent to their respective governments with 30 days to disapprove before the minute goes into effect.[146]

2. Proposal for a PFAS Commission Modeled after the IBWC, with Elevated Requirements for Including Tribes in Decision-making

Here, the governance structure of the IBWC and minute system provides a useful framework for the PFAS protocol. A workable protocol imagines a governing body with technical experts as leads, appointed by the governor of each basin state, and equal representation among the states. Additionally, each tribe in the basin can elect to appoint a representative. Furthermore, the PFAS "commission" should have actual decision-making authority, like the IBWC, to administer responsive actions to PFAS contamination in a similar manner to the minute system.

First, the basin states and tribes should form a base agreement for initial PFAS response measures, analogous to a treaty. Congress will need to approve the interstate agreement, but if the basin states and tribes can form the agreement without much controversy, Congress will likely approve. To ensure effectiveness, flexibility and efficiency should be incorporated in an "amendment" process in anticipation of future PFAS developments to position the commission in a place to meet those challenges as they develop. A swift amendment process is necessary because both PFAS science and drought conditions are rapidly changing.

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140 *Id.*

141 *See id* at 16-17, 36-37.

142 Treaty for Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande art. 25, Mex.-U.S., Feb. 3-Nov. 14, 1944, T.S. No. 944.

143 *Id.*

144 *Id.* at art. 2.

145 *Id.*

146 *Id.* at art. 25.

3. Implementing the PFAS Commission through Cooperative Federalism

Once the salinity-control minute was added to the U.S.-Mexico Treaty, the U.S. had to pass domestic legislation to fund and implement the infrastructure projects necessary to comply with the minute.[147] Thus, Congress passed the Colorado River Basin Salinity Control Act (CRBSCA) in 1974.[148] The U.S. formed its own domestic governance structure to respond to salinity with the Colorado River Basin Salinity Control Forum (CRBSCF), an organization with representatives from each basin state.[149] Once CRBSCF established salinity standards, its members then moved into an advisory role to the Secretary of the Interior (Secretary), charged with implementing the CRBSCA.[150]

This model of cooperative federalism is applicable to the PFAS protocol, with some modifications. For instance, the CRBSCF established the water quality standards for the Secretary to implement.[151] The PFAS protocol should do something similar by allowing the technical commission to decide what PFAS concentration warrants intervention. Usually, the EPA establishes surface water quality standards through the Clean Water Act.[152] Water quality regulation is then delegated to the states to manage within their own borders, so long as the states meet the EPA's requirements.[153] However, with the CRBSCA, salinity regulation was delegated to an interstate forum.[154] The same thing should happen here. Cooperation like this between the EPA and basin states should ensure the latter's PFAS response aligns with the former's. Furthermore, the EPA's delegation could prevent any overlap that would either waste resources or even position the basin states and the EPA in opposition.

To maintain the balance of federal and state power in this system, funding for the PFAS protocol should run through the federal government. The CRBSCA, which is still operational, funds the salinity control program via the Secretary.[155] The Secretary sends a program planning report to Congress, which has 30 days to review it, after which, the Secretary utilizes available funds to implement the program.[156] Here, a parallel process is available, where the PFAS commission sends a planning report to the Secretary, and the Secretary and PFAS commission come to an agreement on funds. The Secretary then sends the planning report to

147 MacDonnell, *supra* note 139, at 36-37.

148 43 U.S.C. §§ 1571-1599, *supra* note 138.

149 MacDonnell, *supra* note 139, at 37.

150 *Id.*; 43 U.S.C. §§ 1571-1599, *supra* note 138, at §1592.

151 MacDonnell, *supra* note 139, at 37.

152 *Id.*

153 *See id; Overview of CWA Section 401 Certification,* ENV'T. PROT. AGENCY, https://www.epa.gov/cwa-401/overview-cwa-section-401-certification (Sept. 27, 2023).

154 43 U.S.C. §§ 1571-1599, *supra* note 138, at § 1594.

155 *See* MacDonnell, *supra* note 139, at 37; *see* Colorado River Basin Salinity Control Act, 43 U.S.C. §§1571-1599 (1980).

156 43 U.S.C. §§ 1571-1599, *supra* note 138, at § 1592(a)(7)(D).

Congress within the 30-day period, and if all goes well, the Secretary releases funds to the commission. This process for the protocol should occur once or twice a year (not before every project) to maintain efficiency.

The PFAS protocol's governance structure will differ from the domestic salinity control program by including tribal representation and incorporating aspects of the international program. It is important to note that tribal representation has historically been absent from water management decisions. As such, the exact governance structure is beyond the scope of this paper and should depend on consultations with the tribes before forming the PFAS governing body. To have the most effective PFAS protocol, the tribes should have autonomy in choosing how they would like to participate.[157]

Like the IBWC's international program, the PFAS commission should continue to have decision-making authority to implement protocols rather than functioning as an advisory council role. Additionally, the PFAS amendment procedure will mirror the IBWC minute system. PFAS amendments will be submitted to the Secretary for approval, and the Secretary will have 30 days to interject before the PFAS commission implements the amendment. Allowing the PFAS commission to retain authority with oversight by the Secretary provides the flexibility to respond to PFAS developments with a federal check to balance power.

B. PFAS Assessment

The PFAS commission's purpose is to implement an assessment in the basin that identifies and protects those at the highest risk of PFAS contamination, described below. Assessments are a necessary tool to collect data and determine who and where is at high risk of contamination exposure.[158] Previous PFAS assessments appear to have occurred reactively and haphazardly.[159] Therefore, the crux of the PFAS protocol is a basin-wide assessment to determine the location of high-risk areas and those who need protection in those areas. Since resources are limited, the PFAS should start their assessments at sources already known to contribute large concentrations of PFAS in the environment: fire response sites, industrial sites, landfills, and wastewater treatment plants.[160] Fortunately, several

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[157] The thirty tribes of the Colorado River basin are fighting to be included in ongoing discussions about the future of the Colorado River Basin. Their exclusion is not only unjust – it also leaves out the creative solutions that tribes have to offer and breeds future conflict when tribes must later pursue litigation to secure basic rights. *See* Ian James, *Tribes seek greater involvement in talks on Colorado River water crisis*, LA TIMES (June 16, 2023), https://www.latimes.com/environment/story/2023-06-16/tribes-push-for-greater-involvement-in-colorado-river-talks; *see also* Letter to Dept. of Interior RE: Tribes seek greater involvement in talks on Colorado River water crisis (July 22, 2022), https://s3.documentcloud.org/documents/22127446/letter-from-btc-to-trujillo-72222.pdf.

[158] *See* ITRC PFAS GUIDANCE, *supra* note 1, at 160.

[159] Typically, PFAS problems are detected over time through mandated EPA monitoring activities or from reports of harm. *Id*. at 37.

[160] *See generally* ITRC PFAS GUIDANCE, *supra* note 1.

research endeavors have mapped out where PFAS contamination has been found and where it is likely to be found in the U.S.[161] Therefore, the data generated thus far provides a starting point to determine where to apply limited sampling resources.[162]

After determining high-risk areas, the PFAS commission should look for the closest "receptors," or specific points where one could "receive" a high dose of PFAS contamination. Receptors closest to high or suspected high concentrations of PFAS should serve as the initial sampling points to determine whether there is a PFAS contamination problem from that source. Targeting receptors in this manner focuses on those most likely to receive high doses of PFAS, irrespective of bureaucratic distinctions such as whether someone's water comes from a public or private source. Thus, high-risk receptors should drive the assessment to maximize efficiency.

In addition to targeting high-risk receptors, the PFAS assessment must be conducted in an environmentally just way. Thus, the PFAS commission should prioritize drinking water testing for the thirty tribes in the basin. A 2022 study that compared the federal testing of tribal public water systems to non-tribal public water systems for PFAS found that tribal public water systems were grossly undertested.[163] Emphasizing testing tribal drinking water sources at the same time as testing high-risk receptors will ensure the PFAS protocol breaks the American tradition of neglecting tribal health and welfare.

As mentioned earlier, the EPA's HAs and proposed drinking water and CERCLA levels are extremely low for sampling.[164] At this time, it may not be technologically or financially feasible to have water samples analyzed for such low concentrations, especially given the number of samples that need to be collected to properly assess the basin for PFAS.[165] Therefore, while the technology is still developing, the PFAS commission should use a risk assessment model, similar to the one in CERCLA.

The main difference between a typical CERCLA assessment and the proposed

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161 *E.g.,* Social Science Environmental Health Research Institute, *PFAS Contamination Site Tracker*, NORTHEASTERN UNIVERSITY, (June 2023), https://experience.arcgis.com/experience/12412ab41b3141598e0bb48523a7c940/page/Page-1/?views=Known-Contamination; ENVIRONMENTAL WORKING GROUP, *Suspected Industrial Discharges of PFAS*, https://www.ewg.org/interactive-maps/2021_suspected_industrial_discharges_of_pfas/map/.

162 For the Colorado River Basin, military bases appear to have the highest concentrations of PFAS compared to other sites. This is because the military conducts firefighting drills and often have to respond to fires on the base. Additionally, PFAS manufacturing facilities are not the only industrial facilities to examine, many manufacturing facilities use or have used PFAS in their processes and should be included in the testing. *See id.*

163 Kira Mok et al., *Federal PFAS Testing and Tribal Public Water Systems*, Env't. Health Perspectives (Dec. 14, 2022), [doi:10.1289/EHP11652] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9749477/.

164 Interview with Dr. Xia, *supra* note 106.

165 *Id.*

basin wide PFAS assessment concerns goals. CERCLA's risk assessment goal is to "determine a safe level for each potentially dangerous contaminant present [at a hazardous waste site]."[166] Conversely, the PFAS assessment goal is to "triage" PFAS contamination, not determine with finality what the "safe levels" for PFAS are. Additionally, it's not possible at this time to determine a safe level for all PFAS, since there are thousands, plus the analytical technology is still in development. Therefore, the goal of the PFAS Protocol is proactive assessment, and the CERCLA risk assessment goal is not applicable. The proposed PFAS assessment should prioritize the level of PFAS contamination that warrants intervention to protect the most at-risk human and environmental receptors.

Once the most at-risk human and environmental receptors are identified, the PFAS commission will have the challenging task of deciding how to protect those receptors. PFAS' unique chemical properties make them difficult to remediate from drinking water sources and the environment since they are resistant to biochemical and thermal treatment processes.[167] At present, PFAS remediation technology is in its infancy and only provides temporary solutions to PFAS contamination.[168] These treatment technologies can immobilize or remove PFAS from a water source, but the technology to reliably destroy PFAS does not yet exist.[169] Thus, the question of how to handle PFAS once they're sequestered from water remains unresolved. Nevertheless, it is important for the commission to implement the available short-term measures to limit exposure, since this will have long-term health benefits.[170] The ongoing progress and uncertainty surrounding PFAS remediation technology highlights the importance of vesting the PFAS commission with the authority and ability to nimbly respond to scientific developments.

A typical CERCLA risk assessment brings stakeholders together and determines what risk is acceptable for the community given the site conditions, contaminants at play, and cost of the remediation to mitigate the risk to an acceptable level.[171] Here, the PFAS assessment should bring together the basin, tribes, and water providers to test for the six PFAS in the EPA's proposed drinking water standards, to decide where to update infrastructure, and ultimately, to determine what level of risk will trigger remediation or intervention to protect human health and the environment.[172]

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166 Environmental Protection Agency, *Superfund Risk Assessment* (July 26, 2022), https://www.epa.gov/risk/superfund-risk-assessment.

167 *See* ITRC PFAS GUIDANCE, *supra* note 1, at 226-227.

168 *See id.*; Interview with Dave Hunter, *supra* note 110.

169 *See* ITRC PFAS GUIDANCE, *supra* note 1, at 226-227.

170 *See id.*, at 356-60.

171 *Id.*; Interview with Dr. Xia, *supra* note 106.

172 The Six PFAS in the NPDWR are PFOA, PFOS, PFNA, PFHxS, PFBS, and Gen X Chemicals. 40 C.F.R. § 141; https://www.epa.gov/sdwa/and-polyfluoroalkyl-substances-pfas

V. CONCLUSION

Anecdotal reports have shown animals exposed to high levels of PFAS had no PFAS detections in their blood after avoiding exposure over time.[173] There is hope for the future, and arming people with the information to limit their exposure will pave the way. It is a privilege to live in one of the most beautiful places on earth, the American West. However, the West was built on water. Today, a historic drought coupled with a particularly toxic and persistent contaminant pose unprecedented challenges for this region. The basin states need to work together, develop a plan, and devote resources to protect the people who depend on precious western water from forever chemicals.

[173] Interview with Dave Hunter, *supra* note 110; ITRC PFAS GUIDANCE, *supra* note 1, at 125.