PFAS Are Forever: Why Unregulated Agricultural Water Is Not a Girl's Best Friend

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INTRODUCTION

"Good God, Joe . . . What the hell is that stuff doing in your water?"
–Regional Environmental Protection Agency (EPA) Scientist[1]

Joe Kiger's water bill reported that his drinking water contained low levels of perfluorooctanoic acid (PFOA), but said not to worry.[2] He lived in Parkersburg, West Virginia, and much of the town worked at DuPont's Washington Works plant.[3] His wife, Darlene, was previously married to a DuPont chemist who had bouts of the so-called "Teflon flu" when he worked with too much PFOA.[4] Darlene remembered that he brought home extra PFOA for cleaning dishes and that DuPont had paid for his schooling and secured their mortgage.[5] But she also remembered that he stopped wearing his work clothes home when their second child was born—DuPont had learned that PFOA was harmful to women and children.[6] Later, Darlene asked herself if PFOA had anything to do with the emergency hysterectomy she needed.[7] When the water bill came, Darlene could not help but wonder what "DuPont ha[d] to do with [their] drinking water."[8]

So Joe asked around and faced slammed doors. The state's Department of Natural Resources "treated [Joe] like [he] had the plague," the water division "shut [him] down," and DuPont "fed [him] the biggest line of [expletive]

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* Editor-in-Chief, 2021–2022. For her unwavering support and incisive questions, I thank Professor Tamara Herrera. For first teaching me how to write, I thank my seventh grade and high school English teacher. For their eagle eyes, I thank all of the *Arizona State Law Journal*. For feeding, caffeinating, and loving me, I thank my friends and family.

1. Nathaniel Rich, *The Lawyer Who Became DuPont's Worst Nightmare*, N.Y. TIMES MAG. (Jan. 6, 2016), https://www.nytimes.com/2016/01/10/magazine/the-lawyer-who-became-duponts-worst-nightmare.html [https://perma.cc/NFG5-TKEG].
2. *Id.*
3. *Id.*
4. *Id.*
5. *Id.*
6. *Id.*
7. *Id.*
8. *Id.*

anybody could have been fed."[9] Finally, the EPA scientist responded, referring Joe to a recently settled lawsuit.[10] Joe soon became a lead plaintiff against DuPont in the first major PFAS litigation.[11]

PFOA is one of countless per- and polyfluoroalkyl substances (PFAS).[12] Today's PFAS start their lives in two ways: electrochemical fluorination or telomerization.[13] Once made, PFAS serve many functions—some invaluable and some trivial—and then relentlessly linger in the environment, earning the name "forever chemicals."[14]

The chemical properties that make PFAS desirable also make them difficult to remove and treat.[15] And effluent leaving a wastewater treatment plant may have *more* PFAS, not less.[16] Instead, the chemicals cycle through our food and water, accumulating in plants, animals, and people.

Concerns about PFAS started in eastern states, where they were manufactured en masse, but western states face a reckoning as litigation spreads and federal regulation falls short. While the EPA's commitment to regulate two key PFAS in drinking water and classify them as hazardous waste is a necessary first step,[17] the uses and varieties of PFAS exploded unfettered for nearly seventy-five years.[18] This is no longer a chemical plant waste problem; PFAS contamination has become a food and water problem.

This Comment will argue that water quality standards are necessary to mitigate the accumulation of PFAS in the food and water of Colorado River beneficiaries. This is best accomplished through a watershed-level cooperative plan benefitting from federal funding and regional flexibility. The Colorado River Basin will serve as a case study because it represents nearly 40 million Americans and 5.5 million acres of irrigated land, providing

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9. *Id.* (expletive omitted in original).

10. *Id.*

11. *See id.*; *see also infra* Part III.A.1.

12. *See infra* Part I.A.

13. *Perfluorooctanoic Acid*, PUBCHEM (Jan. 15, 2022), https://pubchem.ncbi.nlm.nih.gov/compound/9554 [https://perma.cc/3E4M-F3BR].

14. *See* Annie Sneed, *Forever Chemicals Are Widespread in U.S. Drinking Water*, SCI. AM. (Jan. 22, 2021), https://www.scientificamerican.com/article/forever-chemicals-are-widespread-in-u-s-drinking-water/ [https://perma.cc/G9JW-TE7A].

15. *See infra* Part I.A.

16. Melissa M. Schultz et al., *Fluorochemical Mass Flows in a Municipal Wastewater Treatment Facility*, 40 ENV'T SCI. TECH. 7350, 7350, 7356 (2006).

17. *See* EPA, PFAS STRATEGIC ROADMAP: EPA'S COMMITMENTS TO ACTION 2021–2024, 12–13, 17 (2021).

18. *See Our Current Understanding of the Human Health and Environmental Risks of PFAS*, EPA (Oct. 18, 2021) [hereinafter *Our Current Understanding*], https://www.epa.gov/pfas/our-current-understanding-human-health-and-environmental-risks-pfas [https://perma.cc/36ZR-L74E].

water from Cheyenne, Wyoming to Tijuana, Mexico.[19] In a region reliant on transported water, downstream parties are left to deal with upstream sins.

Part I will discuss the science, history, and health effects of PFAS. Part II will examine the existing federal regulatory frameworks for agricultural and drinking water before exploring different state-level approaches, as exemplified by Arizona and California. Part III will provide an overview of PFAS litigation. Part IV will propose a watershed-based regulatory scheme encompassing the Colorado River Basin that considers the many ways we consume and create PFAS.

I. BACKGROUND

PFAS, a problematic byproduct of a twenty-first century existence, increase cancer risks and decrease vaccine efficacy as they accumulate in our bodies primarily through food and water intake.[20] Used in everything from raincoats to firefighting foams, PFAS are of particular concern because carbon-fluorine bonds make them nearly impossible to destroy.[21] PFOA and perfluorooctanesulfonic acid (PFOS) are the most commonly known, but other chemicals gained popularity as PFOA and PFOS fell out of favor.[22] The same traits that make PFAS highly desirable make them problematic—they do not readily break down.[23] As a consequence, PFAS inevitably make their way from useful, seemingly innocuous products into our food and water.[24] Yet, despite their ubiquity, PFAS are largely unregulated.[25]

Much of the regulatory buzz around emerging contaminants has involved drinking water,[26] ignoring the role agricultural water plays in contaminating our food sources.[27] This makes some sense, as drinking water is inherently

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19. U.S. DEP'T OF THE INTERIOR, COLORADO RIVER BASIN: WATER SUPPLY AND DEMAND STUDY 2–3 (2012).

20. *See* ARIZ. DEP'T OF ENV'T QUALITY, EMERGING CONTAMINANTS IN ARIZONA WATER 4-1, A-2 (2016) (explaining exposure methods and potential risks of contaminants in Arizona water).

21. *See* Kerri Jansen, *'Forever Chemicals' No More?*, CHEM. & ENG'G NEWS, Mar. 25, 2019, at 28, 29.

22. *See Our Current Understanding*, *supra* note 18.

23. *Id.*

24. This can happen directly, e.g., when reheating last night's pizza in the delivery box or when rain washes firefighting foams into streams. It can also happen indirectly. If the contaminated stream is diverted for irrigation, crops will absorb and retain the PFAS.

25. ARIZ. DEP'T OF ENV'T QUALITY, *supra* note 20, at 4-2.

26. *See, e.g.*, EPA, FACT SHEET: PFOA & PFOS DRINKING WATER HEALTH ADVISORIES 1 (Nov. 2016).

27. *See* Rosella Ghisi et al., *Accumulation of Perfluorinated Alkyl Substances (PFAS) in Agricultural Plants: A Review*, 169 ENV'T RSCH. 326, 326 (2019).

easier to address because it is treated before use. Conversely, we are generally concerned with agricultural water only after the fact, due to the effects of things like pesticides or increased salinity.[28] That said, E. coli standards show a willingness to regulate agricultural water when needed to protect human health.[29] Regulation has largely been left to the states in the absence of controlling federal standards.[30] This may be effective in parts of the country with localized and abundant water resources, but a piecemeal approach fails to address the competitive and convoluted reality of Western water.

This Part will first examine the history, science, and outlook of PFAS. Next, it will address how PFAS enter our water supply. Last, it will discuss the human health concerns and environmental effects of PFAS accumulation.

A. PFAS: Here for a Long Time, Not for a Good Time

The world first met PFAS in 1946: its name was Teflon, and it was magic.[31] For the first time, America could fry an egg using a new pan and no butter or oil—with virtually no clean-up.[32] Since then, PFAS have been used in water-repellant fabrics, photovoltaic cells, commercial wine filtration, and more.[33] While the uses for PFAS are legion, there are only two major manufacturers in the United States: Chemours (a DuPont spin-off)[34] and 3M.[35]

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28. *See, e.g.*, *Water Contamination*, CTRS. FOR DISEASE CONTROL & PREVENTION (Oct. 11, 2016), https://www.cdc.gov/healthywater/other/agricultural/contamination.html [https://perma.cc/G8W2-NCQL] (primarily describing ways in which agricultural water is contaminated during the course of farming).

29. *See* 21 C.F.R. §§ 112.43–.45 (2021); *see also* FDA, HOW DID FDA ESTABLISH REQUIREMENTS FOR WATER QUALITY AND TESTING OF IRRIGATION WATER? 3 (2017).

30. *See infra* Part II.

31. *See The History of Teflon™ Fluoropolymers*, TEFLON, https://www.teflon.com/en/news-events/history [https://perma.cc/MX4H-UP42].

32. *See* Jolene Worthington, *For Cookware that Lasts a Lifetime, Stick with Winners*, CHI. TRIB. (Sept. 16, 1993), https://www.chicagotribune.com/news/ct-xpm-1993-09-16-9309160026-story.html [https://perma.cc/KRL8-WQEY].

33. *See generally* Juliane Glüge et al., *An Overview of the Uses of Per- and Polyfluoroalkyl Substances (PFAS)*, 22 ENV'T SCI. PROCESSES & IMPACTS 2345 (2020). PFAS use runs the gamut from non-essential (e.g., guitar strings) to essential (e.g., medical devices). *See* Ian T. Cousins et al., *The Concept of Essential Use for Determining When Uses of PFASs Can Be Phased Out*, 21 ENV'T SCI. PROCESSES & IMPACTS 1803, 1805 tbl.1 (2019) (categorizing PFAS uses as "[n]on-essential," "[s]ubstitutable," or "[e]ssential").

34. DuPont spun off PFAS manufacture in a merger with Dow Chemical. Melody M. Bomgardner, *Chemours Begins*, CHEM. & ENG'G NEWS, June 29, 2015, at 5. At the time, Chemours believed it could handle prospective legal liability involving PFAS based on its $6.4 billion in annual sales. *Id.*

35. *3M's Commitment to PFAS Stewardship*, 3M, https://www.3m.com/3M/en_US/pfas-stewardship-us/ [https://perma.cc/A2YL-2JJ5]; *see also* Gabe Schneider, *3M Grilled over PFAS*

Because they do not readily break down, PFAS enter the environment over time, whether by dumping waste into water or by slow loss of particulates into the air. The average person gets their daily dose of PFAS from food and water, but the greatest exposure comes from living near a production plant.[36]

1. Nitty-Gritty of PFAS

PFAS are per- and poly-fluorinated substances.[37] In overly simplified terms, they are chains of mostly carbon and fluorine molecules. The chemical formula of PFOS ($C_8HF_{17}O_3S$), for example, tells us there are eight carbons, only one hydrogen,[38] seventeen fluorines, three oxygens, and a sulfur molecule for good measure.[39] Figure 1 below shows the base "recipe" for PFOS and its sister chemicals. As the most electronegative element in the periodic table, fluorine is highly "attractive" and draws in shared electrons.[40] Because of this trait, carbon-fluorine bonds are short and strong, making PFAS extremely resistant to transformation—thus, "forever chemicals."[41]

Chemicals at Congressional Hearing, MINNPOST (Sept. 11, 2019), https://www.minnpost.com/national/2019/09/3m-grilled-over-pfas-chemicals-at-congressional-hearing/ [https://perma.cc/2FXQ-WA6K].

36. AGENCY FOR TOXIC SUBSTANCES & DISEASE REGISTRY, CTRS. FOR DISEASE CONTROL & PREVENTION, ATSDR-2015-0004, TOXICOLOGICAL PROFILE FOR PERFLUOROALKYLS 3 (2018), https://www.atsdr.cdc.gov/toxprofiles/tp200-c1.pdf [https://perma.cc/75AL-SV22] (draft for public comment).

37. "Poly-" means that there are many bonds. Because chemistry inevitably escalates, "per-" (like "hyper-") tells us the compound is complicated and synthetically produced.

38. This is (partially) where the "per-" comes in. The "simplest" compound with eight carbons would have *eighteen* hydrogens. Here, we have just one.

39. *Perfluorooctanesulfonic Acid*, PUBCHEM [hereinafter PFOS PUBCHEM], https://pubchem.ncbi.nlm.nih.gov/compound/74483 [https://perma.cc/B5TC-SRTH] (providing a comprehensive overview of PFOS's chemical properties, available vendors, etc.); *see also Perfluorooctanoic Acid*, *supra* note 13 (providing a comprehensive overview of PFOA's chemical properties, available vendors, etc.).

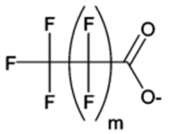
40. *See Periodic Table*, ROYAL SOC'Y OF CHEMISTRY, https://www.rsc.org/periodic-table/trends [https://perma.cc/52E5-43DP] (showing fluorine in upper right corner). *See generally* Anne Marie Helmensteine, *What Is Electronegativity and How Does It Work?*, THOUGHTCO. (Jan. 24, 2020), https://www.thoughtco.com/definition-of-electronegativity-604347 [https://perma.cc/KD8E-ZESV] ("Electronegativity . . . increases with [an atom's] tendency to attract the electrons of a bond.").

41. *See* Mark Brusseau, Professor, Univ. of Ariz., The Occurrence and Fate of Per- and Poly-fluoroalkyl Substances (PFAS) in the Environment (Feb. 2019), https://wrrc.arizona.edu/sites/wrrc.arizona.edu/files/PFAS%20Seminar_Feb%202019_Brusseau.pdf [https://perma.cc/DSM6-ALRT]; *What Are PFAS Chemicals?*, ENV'T WORKING GRP., https://www.ewg.org/pfaschemicals/what-are-forever-chemicals.html [https://perma.cc/QJ9Y-UGF4].

PFAS are both persistent—long-lasting in the environment[42]—and bioaccumulative—building up faster than humans and other species can metabolize or otherwise break them down.[43]

Figure 1. Chemical Models for PFOS, PFOA, and Similar Compounds[44]

n = 5 Perfluorohexanesulfonate (PFHxS)
n = 7 Perfluorooctanesulfonate (PFOS)
n = 9 Perfluorodecanesulfonate (PFDS)



m = 4 Perfluorohexanoate (PFHxA)*
m = 6 Perfluorooctanoate (PFOA)*
m = 7 Perfluorononanoate (PFNA)*
m = 8 Perfluorodecanoate (PFDA)*

Most PFAS are surfactants, with a water-loving (hydrophilic) head and water- *and* oil-repelling (hydro- and oleo-phobic) tail.[45] This tail, consisting of however many carbons and fluorines chained together, is what makes Teflon non-stick.[46] Ironically, long-chain PFAS are highly adsorptive—i.e., sticking to surfaces of soil, water, etc.[47] As a result, long-chain PFAS—with more carbons—are easier to filter from water; short-chain PFAS—with fewer carbons—are almost impossible to remove using current technology.[48]

2. PFOA and PFOS's Rise and Fall: "[C]hemical Whack-a-Mole"[49]

There are many ways to classify PFAS, but an important distinction is short- versus long-chain. Long-chain PFAS have more carbon molecules and

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42. Ian T. Cousins et al., *Why Is High Persistence Alone a Major Cause of Concern?*, 21 ENV'T SCI. PROCESSES & IMPACTS 781, 781–85 (2019).

43. *See Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS)*, NAT'L INST. OF ENV'T HEALTH SCIS. 1, 1 (2019), https://www.niehs.nih.gov/health/materials/perfluoroalkyl_and_polyfluoroalkyl_substances_508.pdf [https://perma.cc/P2ZX-MXAS].

44. Schultz et al., *supra* note 16, at 7351.

45. *See* Brusseau, *supra* note 41. In Figure 1, the oxygen molecules (O) on the right are part of the head; the tail consists of the fluorine molecules (F) attached to unlabeled carbon molecules.

46. *See id.*

47. For example, PFAS used to put out a fire at an airport might mingle with jet fuel and motor oil on the tarmac. When rain comes, the adsorbed PFAS can go farther than if it were traveling solo. *See id.* (discussing non-aqueous-phase liquids such as solvents and fuels).

48. *See* Stephan Brendel et al., *Short-Chain Perfluoroalkyl Acids: Environmental Concerns and a Regulatory Strategy Under REACH*, 30 ENV'T SCIS. EUR. 1, 4 (2018).

49. Abrahm Lustgarten et al., *Suppressed Study: The EPA Underestimated Dangers of Widespread Chemicals*, PROPUBLICA (June 20, 2018),

thus longer chains (and tails).[50] PFOA and PFOS are both long-chain PFAS, while "GenX"[51] and perfluorobutanesulfonic acid (PFBS) are short-chains.[52] Until the early 2000s, DuPont used PFOA to make Teflon,[53] and 3M used PFOS in its Scotchgard technology.[54]

The proliferation of PFAS-based products hit a roadblock in the early 2000s. First, in a 1998 study, 3M found that high concentrations of PFOS killed lab rats and persisted in human blood.[55] Just a year after 3M stopped manufacturing PFOS, researchers found PFOS in bald eagles and Arctic polar bears.[56] The same paper noted that PFOS bioaccumulates much like mercury in fish.[57] Collectively, the data spurred international concern regarding the impacts of PFAS broadly and PFOS specifically. In 2000, the EPA negotiated a voluntary phase-out agreement with 3M.[58] The EPA last recorded domestic

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https://www.propublica.org/article/suppressed-study-the-epa-underestimated-dangers-of-widespread-chemicals [https://perma.cc/72LY-W577].

50. According to Figure 1, a long chain would have upwards of six additional carbons (unmarked intersections), while a short chain might only have one more. *See* Schultz et al., *supra* note 16, at 7351.

51. GenX is used to describe both PFOA alternatives generally and a particular one made by Chemours. *See* EPA, FACT SHEET: DRAFT TOXICITY ASSESSMENTS FOR GENX CHEMICALS AND PFBS 1, 1 (2018), https://www.epa.gov/sites/production/files/2018-11/documents/factsheet_pfbs-genx-toxicity_values_11.14.2018.pdf [https://perma.cc/2N2F-S22V]; *The Devil They Knew: PFAS Contamination and the Need for Corporate Accountability: Hearing Before the Subcomm. on Env't of the Comm. on Oversight & Reform*, 116th Cong. 2–3 (2019) [hereinafter *Hearing*] (statement of Rep. Harley Rouda, Chairman, Subcomm. on Env't of the Comm. on Oversight & Reform) (referring to both "a chemical known as GenX" and "GenX chemicals").

52. PFBS has half as many carbons (four) but is otherwise identical to PFOS. *See* PFOS PUBCHEM, *supra* note 39.

53. *See Teflon Education*, CHEMOURS, https://pages.chemours.com/teflon_education.html [https://perma.cc/8FQM-DKUS] (lasted visited Apr. 9, 2022).

54. *See* David Barboza, *E.P.A. Says It Pressed 3M for Action on Scotchgard Chemical*, N.Y. TIMES (May 19, 2000), https://www.nytimes.com/2000/05/19/business/epa-says-it-pressed-3m-for-action-on-scotchgard-chemical.html [https://perma.cc/MX4C-AJBP].

55. *See id.*

56. *See* John P. Giesy & Kurunthachalam Kannan, *Global Distribution of Perfluorooctane Sulfonate in Wildlife*, 35 ENV'T SCI. & TECH. 1339, 1341–42 (2001).

57. *See id. See generally* Catherine MacDonald, *Seafood, Mercury, and Bioaccumulation*, SAVE OUR SEAS FOUND. (Nov. 1, 2019), https://saveourseas.com/update/seafood-mercury-and-bioaccumulation/ [https://perma.cc/EK7Y-YTMK] (explaining bioaccumulation of mercury and "other persistent pollutants" in fish).

58. The EPA commended 3M's plan to develop alternatives by the end of the year. *See* Press Release, EPA, EPA and 3M Announce Phase Out of PFOS (May 16, 2000), https://archive.epa.gov/epapages/newsroom_archive/newsreleases/33aa946e6cb11f35852568e1005246b4.html [https://perma.cc/5K69-EZAG]; *see also* Barboza, *supra* note 54. 3M's rapid phase-out suggests they entered the agreement with a viable alternative in the wings.

PFOS manufacture in 2002, but it acknowledges the chemical has "limited ongoing uses."[59]

By 2005, the EPA categorized PFOA as having "suggestive evidence of carcinogenic potential."[60] That same year, DuPont settled—for $16.5 million—claims that the company had violated the Toxic Substances Control Act by failing to disclose "substantial risk information" over the past two decades.[61] Roughly $6 million went to Supplemental Environmental Projects.[62] In 2006, the EPA launched its PFOA Stewardship Program, citing concerns about the impacts of long-chain PFAS.[63] The EPA negotiated a voluntary phase-out with eight major PFAS companies[64] that committed to a 95% reduction by 2010 of PFOA and certain precursors in "facility emission" and "product content levels."[65] The phase-out included a softer commitment "to work[] toward[s]" total elimination by 2015.[66]

Voluntary phase-outs make good publicity.[67] As recently as 2019, DuPont pledged to end the use of long-chain PFAS and limit its use of short-chain

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59. The EPA only requires reporting when production exceeds 25,000 pounds at a single site. *Fact Sheet: 2010/2015 PFOA Stewardship Program*, EPA, https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/fact-sheet-20102015-pfoa-stewardship-program [https://perma.cc/JFR9-YFEP].

60. *See* JOYCE M. DONOHUE ET AL., EPA, HEALTH EFFECTS SUPPORT DOCUMENT FOR PERFLUOROOCTANOIC ACID (PFOA) ES-3 to -4 (2016); *see also* EPA, GUIDELINES FOR CARCINOGEN RISK ASSESSMENT 1-12, 2-55 to -56 (2005) (describing EPA's hazard descriptors, including "Suggestive Evidence of Carcinogenic Potential," correlating to "the weight of evidence for carcinogenic hazard potential").

61. Press Release, EPA, EPA Settles PFOA Case Against DuPont for Largest Environmental Administrative Penalty in Agency History (Dec. 14, 2005), https://www.epa.gov/enforcement/reference-news-release-epa-settles-pfoa-case-against-dupont-largest-environmental [https://perma.cc/5R49-QJHU].

62. *See id.*

63. *See Fact Sheet: 2010/2015 PFOA Stewardship Program*, *supra* note 59.

64. The companies are Arkema, Asahi, BASF Corporation (as successor to Ciba), Clariant, Daikin, 3M/Dyneon, DuPont, and Solvay Solexis. *Id.*

65. *Id.*

66. *Id.*

67. *See, e.g.*, *PFAS History*, 3M, https://www.3m.com/3M/en_US/pfas-stewardship-us/pfas-history/ [https://perma.cc/8L9B-3RYZ] (detailing 3M's "stewardship" in phasing out PFOS and PFOA). Another example is Whole Foods' PFAS ban. *See* Waverly Colville, *Whole Foods Removes Packaging with a Cancer-Linked Chemical from Its Stores*, CNBC (Dec. 12, 2018), https://www.cnbc.com/2018/12/11/whole-foods-removes-packaging-with-a-cancer-linked-chemical.html [https://perma.cc/7JZ6-FF9N]. The ban came after a watchdog study cited Whole Foods as the worst offender—ahead of conventional grocery chains—for elevated fluorine levels in to-go food packaging, suggestive of PFAS treatment. Press Release, Safer Chemicals, Healthy Families, New Study Finds Nonstick PFAS Chemicals in Takeout Packaging at Top Grocery Stores (Dec. 11, 2018), https://saferchemicals.org/2018/12/11/new-study-finds-nonstick-pfas-chemicals-in-takeout-packaging-at-top-grocery-stores/ [https://perma.cc/3RSH-Z9AL].

PFAS "where possible."[68] 3M's website touts their 2000 PFOS phase-out as an example of industry leadership.[69] Gore Fabrics proudly announced being "one of the first companies in the sector to successfully changeover [sic] to PFOA-free raw materials" in 2014[70] and has since sought to eliminate both long- and short-chain PFAS from its consumer fabrics.[71]

While public opinion has turned on PFOA and PFOS, chemical companies tout short-chain PFAS as safe replacements.[72] In particular, Chemours' "GenX" has largely replaced PFOA, and PFBS is a common PFOS alternative.[73] Short-chain PFAS are less bioaccumulative than their long-chain counterparts but are "just as persistent."[74] Worse, some are also less

68. Marc S. Reisch, *DuPont To End Use of PFAS Chemicals*, CHEM. & ENG'G NEWS (Aug. 30, 2019), https://cen.acs.org/environment/persistent-pollutants/DuPont-end-use-PFAS-chemicals/97/i34 [https://perma.cc/56WT-5E24]. DuPont had already agreed to significantly reduce PFOA use by 2010. *See Fact Sheet: 2010/2015 PFOA Stewardship Program*, *supra* note 59. And because of the 2015 Chemours spin-off, DuPont no longer manufactures PFAS and has less of a stake in their success. *See* Bomgardner, *supra* note 34, at 5.

69. The same page declares that 3M makes PFAS for "everyday products." *PFAS History*, *supra* note 67. PFBS-based surfactants were on the market by 2002. *See Technical Data Bulletin: Environmental, Health, Safety, and Regulatory (EHSR) Profile of Perfluorobutane Sulfonate (PFBS)*, 3M 1, 1 (2002) https://multimedia.3m.com/mws/media/172303O/ehsr-profile-of-perfluorobutane-sulfonate-pfbs.pdf [https://perma.cc/H6NG-U69P].

70. Press Release, GORE-TEX, Gore Completes Elimination of PFOA from Raw Material of Its Functional Fabrics (Jan. 10, 2014) https://www.gore-tex.com/pressroom/press-release/responsibility-sustainability/gore-completes-elimination-of-pfoa-from-raw-material-of-its-functional-fabrics [https://perma.cc/9HE6-N3UM].

71. GORE-TEX, Webinar on Gore Fabrics' Goals on PFCs of Environmental Concern (Mar. 21, 2017). The company's updated plan "follow[ed] an intense and fruitful discussion with Greenpeace," who shared a press release celebrating the commitment. 2018 ANNUAL UPDATE ON "GORE FABRICS' GOAL AND ROADMAP FOR ELIMINATING PFCS OF ENVIRONMENTAL CONCERN," GORE FABRICS 1, 1 (2018); *see* Press Release, Greenpeace Int'l, Pledge by Market Leader Gore Could Make Hazardous PFCs in Outdoor Gear a Thing of the Past (Feb. 6, 2017), https://www.greenpeace.org/international/press-release/7231/pledge-by-market-leader-gore-could-make-hazardous-pfcs-in-outdoor-gear-a-thing-of-the-past/ [https://perma.cc/WU7M-RHTV].

72. *See, e.g.*, 3M, *supra* note 69 (discussing PFBS as having "very different environmental and toxicity properties" than PFOS).

73. *See* EPA, *supra* note 51, at 1.

74. Stephen K. Ritter, *Fluorochemicals Go Short*, 88 CHEM. & ENG'G NEWS 12, 12–17 (2010); *see* AM. WATER WORKS ASS'N, PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) 4 (2019). *But see* DANISH ENV'T PROT. AGENCY, SHORT-CHAIN POLYFLUOROALKYL SUBSTANCES (PFAS) 23 (2015).

effective.[75] And short-chain PFAS are often harder to filter out because of their small size.[76]

Another concern is that manufacturers are aggressively pushing short-chain PFAS on an unsuspecting public.[77] The scientific community is still learning about traditional PFAS; states and the federal government have largely done nothing to regulate them.[78] As noted before the House Subcommittee on the Environment, "the true impact of GenX may take years to become known."[79] In that same hearing, a PFAS immunotoxicology researcher emphasized that short-chain PFAS may have a "more favorable toxicological profile" but remain objectively toxic.[80] GenX is likely more toxic than its predecessor.[81] When chemical manufacturers play "chemical whack-a-mole,"[82] they do so with consequences.

Only time will tell if short-chain PFAS are forever chemicals.[83] In the meantime, long-chain PFAS are living up to the moniker: levels hold steady—and even increase—in drinking water despite significant reductions in their production and use.[84] Regardless, the shift from long- to short-chain PFAS demonstrates that agility is vital in reacting to the chemical industry.

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75. *See* INTERSTATE TECH. & REGUL. COUNCIL, HISTORY AND USE OF PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) 4 (2020); *see also* Sylvia Carignan, *Creating 'Forever Chemicals': A Guide to PFAS Companies (2)*, BLOOMBERG LAW (Feb. 13, 2020), https://news.bloomberglaw.com/environment-and-energy/creating-forever-chemicals-a-guide-to-pfas-companies [https://perma.cc/D8PM-AB2Y].

76. See *infra* notes 108–109 and accompanying text.

77. *Hearing*, *supra* note 51, at 41; DANISH ENV'T PROT. AGENCY, *supra* note 74, at 9 (discussing "general lack of toxicological information regarding the short-chain PFAS").

78. *See infra* Part III.

79. *Hearing*, *supra* note 51, at 8 (statement of Emily Donovan, Co-Founder, Clean Cape Fear).

80. *Id.* at 50 (statement of Dr. Jamie C. DeWitt, Associate Professor, East Carolina University).

81. Melissa I. Gomis et al., *Comparing the Toxic Potency In Vivo of Long-chain Perfluoroalkyl Acids and Fluorinated Alternatives*, ENV'T INT'L 1, 6 (2018).

82. Lustgarten et al., *supra* note 49.

83. DANISH ENV'T PROT. AGENCY, *supra* note 74, at 7–9.

84. Elsie M. Sunderland et al., *A Review of the Pathways of Human Exposure to Poly- and Perfluoroalkyl Substances (PFASs) and Present Understanding of Health Effects*, 29 J. EXPOSURE SCI. ENV'T EPIDEMIOLOGY 131, 131 (2018).

B. PFAS in Water: Where Does It Come from . . . Where Does It Go?

PFAS get around by "sticking" to something.[85] Of the key transportation modes for PFAS—water, air, and soil—scientists best understand water.[86] Bypassing the complexities of fate and transport, regulators often think of where the "dirty" water came from—either point or nonpoint sources[87]—and what it will be used for.[88] Point sources are typically discrete while nonpoint sources are diffuse.[89]

Point sources can be divided into three categories: manufacture,[90] use,[91] and waste.[92] PFAS are not naturally-occurring and must be synthetically manufactured—no PFAS plants, no PFAS.[93] Thus, chemical manufacturers like 3M and Chemours make convenient, albeit expensive, targets for both regulation and litigation.[94] No one manufactures PFOA and PFOS domestically, but companies still produce other long- and short-chain PFAS en masse.[95] Product manufacturers then turn PFAS chemicals into goods used across countless sectors.[96] If manufacturers perfectly treated their waste

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85. *See generally* INTERSTATE TECH. & REGUL. COUNCIL, PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) 68–80 (2020) (providing a technical overview of PFAS fate and transport); DANISH ENV'T PROT. AGENCY, *supra* note 74, at 49–73 (discussing data on the fate of long- and short-chain PFAS or the lack thereof).

86. DANISH ENV'T PROT. AGENCY, *supra* note 74, at 8–9. It also implicates the other modes. *See, e.g.*, CITY OF PHX., 2019 WATER QUALITY REPORT 2 (2019) ("It is reasonable to expect drinking water . . . to contain at least small amounts of some contaminants."). Air and soil are not the subject of this paper beyond their presence in water.

87. *Basic Information About Nonpoint Source (NPS) Pollution*, EPA (July 8, 2021), https://www.epa.gov/nps/basic-information-about-nonpoint-source-nps-pollution [https://perma.cc/V2JN-WHXF].

88. See *infra* Part III.A & III.B.

89. *Basic Information About Nonpoint Source (NPS) Pollution*, *supra* note 87. Snowmelt runoff is a classic nonpoint source. *Id.*

90. For example, chemical companies, such as DuPont and 3M, or product manufacturers. *See PFAS: Background*, CAL. WATER BDS. (Oct. 27, 2020), https://www.waterboards.ca.gov/pfas/background.html [https://perma.cc/FAX3-PXF4].

91. For example, the military bases and airports using firefighting foams, or someone routinely overheating their Teflon pan on the stove. *See id.*

92. For example, landfills and wastewater treatment plants. *See id.*

93. This is distinct from naturally occurring compounds that are impossible to wholly eradicate: Estrogen levels in drinking water might decline with reduced use of hormonal birth control, but the hormone's natural occurrence prevents levels from ever reaching zero without water treatment. *See* Daniel J. Caldwell et al., *An Assessment of Potential Exposure and Risk from Estrogen in Drinking Water*, 118 ENV'T HEALTH PERSP. 338, 340 (2009).

94. *See infra* Part IV.

95. *See* INTERSTATE TECH. & REGUL. COUNCIL, *supra* note 75, at 4–5 (explaining that China, India, and Russia still produce PFOA, but as of 2017, China was the only country still producing PFOS).

96. *Id.* at 5 tbl.4-1.

streams, manufacture would not be a major point source; as is, PFAS plants are a blight to nearby waterways.[97]

Use is a pernicious category, as both the product manufacturer and the end user contribute to PFAS pollution. For example, while chemical reactions typically consume PFOA and its alternatives during manufacture,[98] end products often contain PFOS and its substitutes.[99] PFAS are found in semiconductor finishes, biocides, and food wrappers.[100] Near airports and in regions with a strong Air Force presence—like the Colorado River Basin—a type of high-performance flame retardants, called aqueous film-forming foams (AFFFs), is a common source of PFAS water pollution.[101]

Waste is a natural consequence of both manufacture and use. Manufacturers dump raw PFAS waste into local water supplies at highly concentrated levels.[102] Downstream users discard PFAS products in the trash—at industrial and individual scales—and send PFAS down the toilet.[103] Thus, landfills and wastewater treatment plants are another major point source for PFAS,[104] albeit less so than a PFAS manufacturing facility in the same watershed.[105] Unfortunately, conventional water treatment systems are ill-equipped to remove these substances, and solutions can be costly.[106] And

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97. *Id.*

98. A consumer is unlikely to possess PFOA. They may own a Teflon pan, but that is made of PTFE, a fluoropolymer *made* from PFOA. EPA, DRINKING WATER HEALTH ADVISORY FOR PERFLUOROOCTANOIC ACID (PFOA) 15 (2016).

99. PFOS is an active ingredient in firefighting foams and oil-well surfactants. N.Y. STATE POLLUTION PREVENTION INST., PER- AND POLYFLUORINATED SUBSTANCES IN FIREFIGHTING FOAM 9 (2019).

100. Think of anything that comes in flimsy tissue-paper wrappers, e.g., bagel sandwiches, or croissants. Brusseau, *supra* note 41, at 14. OECP/UNEP GLOB. PFC GRP., SYNTHESIS PAPER ON PER- AND POLYFLUORINATED CHEMICALS (PFCS) 11–12 (2013). Turtle-friendly straws are a new PFAS culprit. Katherine Bourzac, *'Biodegradable' Drinking Straws Contain PFAS*, CHEM. & ENG'G NEWS (Mar. 29, 2021), https://pubs.acs.org/doi/10.1021/cen-09911-scicon2 [https://perma.cc/6GPA-VTZ6].

101. *See* Jen Fifield, *Not Just Luke: Water in 9 Other Arizona Places Has Tested High for Firefighting Foam Toxins*, AZCENTRAL (May 2, 2019), https://www.azcentral.com/story/news/local/tempe/2019/05/02/water-9-arizona-systems-have-tested-high-toxins-found-luke-air-force-base/3485082002/ [https://perma.cc/FTU3-CHDJ].

102. *See* INTERSTATE TECH. & REGUL. COUNCIL, *supra* note 75, at 7.

103. *See* PFAS Response Team, *Wastewater Treatment Plants / Industrial Pretreatment Program*, STATE OF MICH. (Dec. 2, 2020), https://www.michigan.gov/pfasresponse/0,9038,7-365-88059_91299---,00.html [https://perma.cc/TS5R-2PAD].

104. OECP/UNEP GLOB. PFC GRP., *supra* note 100, at 20–21.

105. Sunderland et al., *supra* note 84, at 133–35.

106. *See* Jansen, *supra* note 21, at 29–32.

wastewater treatment processes can trigger precursor degradation, meaning effluent often leaves a plant with *more* PFAS.[107]

While activated-carbon technology can remove long-chain PFAS, short-chains are able to literally slip through.[108] Short-chain PFAS require processes such as reverse osmosis that result in highly-concentrated waste streams requiring safe disposal.[109] Thus, as water treatment adapts to address PFAS, waste management must rise to the forefront.[110] When point sources fail to address PFAS, they perpetually circulate through our environment—whether short- or long-chain.[111]

PFAS reach surface water through stormwater runoff or direct dumping,[112] and reach groundwater through waste disposal and leaching from soil.[113] Regardless of its source, agricultural and drinking water cycles PFAS through the environment. For those near a point source, drinking water is the most common means of exposure.[114] While much of the Colorado River Basin had undetectable levels of PFOS and PFOA in a 2016 survey of EPA reporting data, Arizona's and Southern California's metropolitan areas reported PFOS above the EPA's (nonmandatory) lifetime health advisory limit.[115]

But PFAS are here to stay. DuPont and 3M began manufacturing PFAS in the 1940s, well before notions of water quality regulation.[116] Even if PFAS

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107. *See* Schultz et al., *supra* note 16, at 7350.

108. *See Reducing PFAS in Drinking Water with Treatment Technologies*, EPA (Aug. 23, 2018), https://www.epa.gov/sciencematters/reducing-pfas-drinking-water-treatment-technologies [https://perma.cc/89WS-UPMN].

109. *See id.* Activated carbon has its own waste problems: it is typically disposed of via incineration, which releases PFAS into the air. *See* Jansen, *supra* note 21, at 30–31. Thus, removing PFAS from the water supply manages a dispersed problem by creating a concentrated waste problem.

110. *See* Jansen, *supra* note 21, at 31–32.

111. *See* DANISH ENV'T PROT. AGENCY, *supra* note 74, at 49–52.

112. *See Wastewater Workgroup*, MICH. PFAS ACTION RESPONSE TEAM https://www.michigan.gov/pfasresponse/0,9038,7-365-86513_99807_99808-528011--,00.html [https://perma.cc/9NNA-7QYU].

113. *See* Jennifer Bräunig et al., *Leaching and Bioavailability of Selected Perfluoroalkyl Acids (PFAAs) from Soil Contaminated by Firefighting Activities*, 646 SCI. TOTAL ENV'T 471, 471 (2019).

114. *See* Kyle Steenland et al., *Epidemiologic Evidence on the Health Effects of Perfluorooctanoic Acid (PFOA)*, 118 ENV'T HEALTH PERSPS. 1100, 1100 (2010); *see also, e.g.*, Kellyn S. Betts, *A Measure of Community Exposure: PFOA in Well Water Correlates with Serum Levels*, 119 ENV'T HEALTH PERSPS. A35, at A35 (2011) (reporting PFOA contamination in private wells near a DuPont plant).

115. *See* Brusseau, *supra* note 41. The EPA's lifetime health advisory levels are discussed *infra*.

116. *See Our Current Understanding*, *supra* note 18; *History of the Clean Water Act*, WATERSHED ACAD. WEB,

use halted today, there are decades of contamination to reckon with.[117] Through water, PFAS reach our bodies and the environment, creating risks of cancer, endocrine disruption, and more.[118] To paraphrase musical artist John Mayer, "it [won't] wash out in the water . . . it is always in the blood."[119]

C. Adverse Effects of PFAS

Ninety-seven percent of people in the United States have detectable levels of PFAS in their blood.[120] PFAS also accumulate in lung tissue.[121] The levels of PFOA and PFOS in blood have decreased in recent years, tracking with their decline in popularity.[122] Blood serum levels of short-chain PFAS and other long-chain PFAS are on the rise, although many short-chain PFAS have reduced half-lives.[123] While the chemical industry touts short-chains as more safe (if not entirely safe), many of the same concerns linger.[124]

Existing research links PFAS to numerous health effects.[125] In both humans and animals, PFAS act as endocrine-disruptors and increase the incidence of certain cancers.[126] PFAS are difficult to study in humans because it is hard to find unexposed individuals for control groups,[127] and cross-species comparison is problematic.[128] Still, laboratory studies confirm that

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https://cfpub.epa.gov/watertrain/moduleFrame.cfm?parent_object_id=2571 [https://perma.cc/6DR7-W4QN] (recalling how a river catching fire spurred federal water regulation).

117. *See Our Current Understanding*, *supra* note 18.

118. *See id.*

119. JOHN MAYER, *In the Blood*, *on* THE SEARCH FOR EVERYTHING (Columbia Records 2017).

120. Brusseau, *supra* note 41.

121. *See* Francisca Pérez et al., *Accumulation of Perfluoroalkyl Substances in Human Tissues*, 59 ENV'T INT'L 354, 354 (2013); *see also* DANISH ENV'T PROT. AGENCY, *supra* note 74, at 23–24.

122. *See* Brusseau, *supra* note 41.

123. *See* DANISH ENV'T PROT. AGENCY, *supra* note 74, at 23–25, 75.

124. *See These Chemicals Are Forever: Water Contamination from PFOA, PFOS, and Other PFAS*, FOOD & WATER WATCH (Feb. 6, 2019), https://www.foodandwaterwatch.org/wp-content/uploads/2021/03/ib_1812_pfas-web.pdf [https://perma.cc/P2TR-XS3V]; *supra* Part I.A.2.

125. *See Our Current Understanding*, *supra* note 18.

126. *See id.*

127. *See, e.g.*, Zeyan Liew et al., *Developmental Exposures to Perfluoroalkyl Substances (PFASs): An Update of Associated Health Outcomes*, 5 CURRENT ENV'T HEALTH REPS. 1 (2018) (discussing challenges associated with PFAS research including, among other things, the unavailability of control groups).

128. In particular, half-life varies across PFAS and species. PFOA has an estimated half-life of eight years in humans and no more than 16.2 hours in female rats. AGENCY FOR TOXIC

PFAS adversely affect animal species.[129] And panic surrounding the discovery of PFOS in wildlife partly drove the compound's demise.[130] Despite this, there is little research into PFAS' impacts on wildlife or domesticated species.[131] Thus, PFAS exposure is troubling for what we know and don't know about their effects—in both humans and the environment. In a chicken-and-the-egg situation, a lack of data prevents clear regulation, and a lack of regulation prevents clear data.

1. Human Health

Humans eat and breathe PFAS.[132] There are two primary areas of concern: environmental exposure and early developmental exposure.[133] Dietary consumption is the primary means of environmental exposure for the general public, surpassed by air exposure for the "occupationally exposed."[134] In 2018, the Centers for Disease Control and Prevention (CDC) published a then-controversial 853-page report—which notably widened its research beyond just PFOA and PFOS—associating PFAS with pregnancy-induced hypertension, liver damage, thyroid disease, decreased vaccine antibody response, and risk of decreased fertility.[135] Studies also report increased

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SUBSTANCES & DISEASE REGISTRY, *supra* note 36, at 4. Thus, it takes 0.06% of a rat's three-year life for PFOA to halve in concentration. *See* Pallav Sengupta, *The Laboratory Rat: Relating Its Age with Human's*, 4 INT'L J. PREVENTIVE MED. 624, 626 (2013). Conversely, it takes 10% of the average American's life (78.8 years) to see the same change. *See* Jiaquan Xu et al., *Deaths: Final Data for 2019*, NAT'L VITAL STAT. REPS., at 1 (July 26, 2021), https://www.cdc.gov/nchs/data/nvsr/nvsr70/nvsr70-08-508.pdf [https://perma.cc/3ZPA-VHP3]. *See generally* Sengupta, *supra*, at 624–29 (comparing ages of lab rats with that of humans).

129. *See* AGENCY FOR TOXIC SUBSTANCES & DISEASE REGISTRY, *supra* note 36, at 6–15.

130. *See* Giesy & Kannan, *supra* note 56, at 1341–42.

131. *See, e.g.*, *Pets and Livestock Health*, MICH. PFAS ACTION RESPONSE TEAM, https://www.michigan.gov/pfasresponse/0,9038,7-365-86704_86709---,00.html [https://perma.cc/56Y4-5N6U] ("Lifetime health advisory levels for PFAS have not yet been formulated specifically for pets or livestock.").

132. *See* AGENCY FOR TOXIC SUBSTANCES & DISEASE REGISTRY, *supra* note 36, at 2.

133. Direct exposure includes point sources, drinking water, air particulates, food, etc. *See* Liew et al., *supra* note 127. Prenatal exposure involves in utero exposure to PFAS in a mother's blood and tissues. For the purposes of this paper, "early developmental" includes prenatal and breast-feeding exposure. *See id.*; AGENCY FOR TOXIC SUBSTANCES & DISEASE REGISTRY, *supra* note 36, at 1–3 (discussing environmental as well as prenatal and infant exposure).

134. AGENCY FOR TOXIC SUBSTANCES & DISEASE REGISTRY, *supra* note 36, at 3–4.

135. *See id.* at 5–6. *See generally* Annie Snider, *White House, EPA Headed off Chemical Pollution Study*, POLITICO (May 14, 2018), https://www.politico.com/story/2018/05/14/emails-white-house-interfered-with-science-study-536950 [https://perma.cc/MWY8-BAW7] (describing efforts to bury the report).

osteoarthritis and risk of early menopause in women, but with less certainty.[136]

Environmental exposure includes both point sources[137] and downstream uses.[138] Concentration varies widely by means of exposure and is directly tied to health effects. Ongoing consumption of polluted drinking water, particularly by a manufacturing-plant worker who inhales PFAS particulates at work, is likely the worst case for exposure; exposure from routine use of a Teflon pan is much lower.[139] It is easier to identify PFAS as a root cause when someone has fewer, more concentrated points of exposure.[140] Conversely, it is difficult to isolate PFAS as the culprit when faced with thousands of low-concentration exposures.[141] In part, it is easier to spot the elephant in the room than a needle in a haystack. Not to mention, heightened exposure brings heightened health effects.[142] For example, individuals with high levels of PFAS exposure face an increased risk of testicular and kidney cancer.[143]

Much of PFAS research is concerned with prenatal exposure.[144] A 2018 study found 5.5 parts per trillion (ppt) PFOA and 14 ppt PFOS in expectant mothers' blood—nearly 28% of the EPA's combined advisory limit for

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136. *See* AGENCY FOR TOXIC SUBSTANCES & DISEASE REGISTRY, *supra* note 36, at 6.

137. For example, a manufacturing plant that dumps PFAS in a river used for drinking water.

138. For example, a pizza box. *See supra* note 24.

139. The average blood serum concentration of PFOA for a worker at the Washington Works DuPont plant in the early 2000s was 1,000 ng/mL. AGENCY FOR TOXIC SUBSTANCES & DISEASE REGISTRY, *supra* note 36, at 6. Mean exposure in the mid-2000s amongst the general population was only 4.91 ng/mL. *Id.*

140. *Cf. What You Should Know About Arsenic in Arizona Groundwater*, ARIZ. DEP'T OF HEALTH SERVS., https://www.azdhs.gov/documents/preparedness/epidemiology-disease-control/environmental-toxicology/well-water/arsenic.pdf [https://perma.cc/V25N-SBUU] (listing cancer and death as symptoms of high-level arsenic exposure).

141. *See generally* Albert C. Lin, *Beyond Tort: Compensating Victims of Environmental Toxic Injury*, 78 S. CAL. L. REV. 1439 (2005) (discussing the challenge of litigating toxic tort claims based on ongoing, low-level exposure). Findings like increased cholesterol levels or increased susceptibility to illness may be particularly difficult to link to prolonged low-level PFAS exposure. *See Our Current Understanding*, *supra* note 22.

142. *Cf. What You Should Know About Arsenic in Arizona Groundwater*, *supra* note 140. Exposure limits fundamentally reflect this. *See, e.g.*, EPA, *supra* note 26, at 1–2 (describing exposure limits for PFOA and PFOS and the process by which those limits are set).

143. AGENCY FOR TOXIC SUBSTANCES & DISEASE REGISTRY, *supra* note 36, at 6.

144. *See* Jessica Shoaff et al., *Prenatal Exposure to Perfluoroalkyl Substances*, ENV'T EPIDEMIOLOGY, June 2018; Rong Huang et al., *Prenatal Exposure to Perfluoroalkyl and Polyfluoroalkyl Substances and the Risk of Hypertensive Disorders of Pregnancy*, ENV'T HEALTH, Jan. 9, 2019; Sverre Wikström et al., *Maternal Serum Levels of Perfluoroalkyl Substances in Early Pregnancy and Offspring Birth Weight*, 87 PEDIATRIC RSCH. 1093, 1093 (2020).

water.[145] The same study tied PFOA to lower infant birth weights.[146] While the CDC report linked PFOA and PFOS to "small . . . decreases in birth weight," "small" is relative when considering a newborn.[147] Infants with low birth weights are more likely to have short-term health issues, such as breathing problems, brain bleeds, and an increased risk of infection.[148]

Downstream consequences of prenatal and early-childhood exposure are also of concern. While research on neurodevelopmental issues and allergic diseases has been less conclusive, results involving the immune system are troubling and salient.[149] Prenatal PFAS exposure harms a child's immune system.[150] Several studies found a link between increased prenatal PFAS exposure and decreased vaccine-produced antibody levels for rubella, diphtheria, and tetanus in young children.[151]

Antibody levels are a measure of a vaccine's efficacy—more antibodies, more immunity.[152] The reduced vaccine efficacy caused by PFAS exposure persists in older children and adolescents, who may face environmental exposure as well.[153] Studies of flu and measles vaccines were less conclusive than those of rubella, diptheria, and tetanus vaccines,[154] which may bode well for the various COVID-19 vaccines.[155] Still, the CDC acknowledges that

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145. *See* Shoaff et al., *supra* note 144.

146. *See id.* The 2018 study was concerned that low birth weights are often linked to rapid infant growth, which is tied to obesity later in life. *See id.* Fortunately, the 2018 study found only a weak correlation between PFAS and rapid infant growth. *See id.*

147. The report defined "small" as "<20 g or 0.7 ounces per 1 [ppt] increase in blood perfluoroalkyl level." *Per- and Polyfluoroalkyl Substances (PFAS) and Your Health*, AGENCY FOR TOXIC SUBSTANCES & DISEASE REGISTRY (June 24, 2020), https://www.atsdr.cdc.gov/pfas/health-effects/index.html [https://perma.cc/G7G9-5NRM]; AGENCY FOR TOXIC SUBSTANCES & DISEASE REGISTRY, APPENDIX A. ATSDR MINIMAL RISK LEVEL WORKSHEETS, at A-6, https://www.atsdr.cdc.gov/ToxProfiles/tp200-a.pdf [https://perma.cc/RJW2-WVTF].

148. *See Low Birthweight*, MARCH OF DIMES (June 2021), https://www.marchofdimes.org/complications/low-birthweight.aspx [https://perma.cc/VU4K-TWRQ].

149. *See* Liew et al., *supra* note 127.

150. *See id.*

151. *See id.* at 4.

152. *See* Claire-Anne Siegrist, *Vaccine Immunology*, *in* VACCINES 17, 17 (Stanley A. Plotkin et al. eds., 5th ed. 2008).

153. *See* Liew et al., *supra* note 127, at 4.

154. *See id.*

155. *See generally Understanding How COVID-19 Vaccines Work*, CTRS. FOR DISEASE CONTROL & PREVENTION (Mar. 9, 2021), https://www.cdc.gov/coronavirus/2019-ncov/vaccines/different-vaccines/how-they-work.html [https://perma.cc/D3BY-8JNL] (describing the efficacy of COVID-19 vaccines and how they work). Since PFAS does not have a uniform negative effect on vaccine responses, the new COVID vaccines may not be affected. *See supra* notes 149–154 and accompanying text.

PFAS exposure may reduce the efficacy of a vaccine and is studying the issue.[156]

Prenatal PFAS exposure also worsens the severity and duration of illnesses later in life, including symptoms like a fever or cough.[157] This suggests prenatal or early-childhood exposure may adversely affect the body's ability to fight COVID-19.[158] A recent study of Danish COVID patients supports this theory: severe symptoms were more likely in those with high levels of the short-chain perfluorobutyrate (PFBA).[159] 3M rejects any such connection.[160] Only time will tell, as there is much to learn about the mechanisms of both PFAS and COVID-19.[161]

2. Environmental Issues

Perpetual and impartial, PFAS affect flora and fauna alike.[162] Most information on PFAS' impact on animal species is from laboratory studies; wildlife is under-researched.[163] Lab studies show that PFAS cause liver, thyroid, and reproductive diseases, and stunt development in animals.[164] Studies of monkeys, rats, and mice report skeletal defects, altered puberty,

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156. *See Per- and Polyfluoroalkyl Substances (PFAS) and Your Health*, *supra* note 147. The University of Arizona is leading three studies of front-line workers, exploring PFAS exposure's impact on COVID-19's severity and the vaccines' efficacy. *See* Tony Davis, *New University of Arizona Studies Looking at Possible PFAS-COVID-19 Link*, TUCSON.COM (Feb. 15, 2021), https://tucson.com/news/local/new-university-of-arizona-studies-looking-at-possible-pfas-covid-19-link/article_a12e4a8c-5cdc-5579-88c5-128327bfa1df.html [https://perma.cc/9GRT-LQDR].

157. *See* Liew et al., *supra* note 127, at 4.

158. *See id.*; *Per- and Polyfluoroalkyl Substances (PFAS) and Your Health*, *supra* note 147.

159. *See* Rebecca Trager, *PFAS Exposure Found To Increase Risk of Severe Covid-19*, CHEMISTRY WORLD (Jan. 12, 2021), https://www.chemistryworld.com/news/pfas-exposure-found-to-increase-risk-of-severe-covid-19/4012992.article [https://perma.cc/E5W4-3TNJ].

160. *See* Sharon Lerner, *PFAS Chemical Associated with Severe COVID-19*, INTERCEPT (Dec. 7, 2020), https://theintercept.com/2020/12/07/pfas-pfba-severe-covid-study/ [https://perma.cc/YW6T-RR93]; Press Release, 3M, No Evidence Linking PFAS and COVID-19 (Nov. 24, 2020), https://news.3m.com/English/3m-stories/3m-details/2020/No-Evidence-Linking-PFAS-and-COVID-19/ [https://perma.cc/A9VR-PRSZ]. For more information on PFBA, see *PFBA and Drinking Water*, MINN. DEP'T OF HEALTH 1 (2017).

161. *See, e.g.*, Michael Marshall, *How COVID-19 Can Damage the Brain*, 585 NATURE 342, 342 (2020) ("[R]esearchers are struggling to answer key questions—including basic ones . . . .").

162. *See* Derek Muir et al., *Levels and Trends of Poly- and Perfluoroalkyl Substances in the Arctic Environment—An Update*, 5 EMERGING CONTAMINANTS 240, 240 (2019); Jing Ma et al., *Fecal Excretion of Perfluoroalkyl and Polyfluoroalkyl Substances in Pets from New York State, United States*, 7 ENV'T SCI. & TECH. LETTERS 135, 135 (2020).

163. *See Environmental and Health Impacts of PFAS*, WIS. DEP'T OF NAT. RES., https://dnr.wisconsin.gov/topic/Contaminants/PFAS.html [https://perma.cc/XBU4-XGNZ].

164. *See Pets and Livestock Health*, *supra* note 131.

and cancer due to PFAS exposure.[165] Aquatic species are particularly vulnerable to PFAS.[166] In livestock, PFAS contamination can harm the animal and pollute food products like dairy and beef.[167]

PFAS' presence in plants—especially food crops—is also important.[168] Studies show short-chain PFAS may be more bioaccumulative than long-chains in vegetables and grains.[169] Shoot vegetables like lettuce had higher concentrations of PFAS than other vegetables.[170] While it is unclear whether PFAS actively harm plants,[171] they undeniably travel up the food chain.[172]

Almost 75 years after entering the market, PFAS have forever changed our homes, bodies, and the environment. PFAS' nonstick properties, low surface tension, and non-reactivity revolutionized home goods, medical devices, and more.[173] And, as it turns out, PFAS are still slippery once in the environment, readily moving through our food and water. Persistent and transient, PFAS demand regulation that is enduring and dynamic.

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165. *See* DONOHUE ET AL., *supra* note 60, at ES-2.

166. *See, e.g.*, Rachael Pacella, *Anne Arundel County Firefighting Foam Spill Causes Fish Kill; PFAs Found in Bear Branch Stream*, BALTIMORE SUN (Nov. 11, 2020), https://www.baltimoresun.com/news/environment/ac-cn-firefighting-foam-1110-20201111-ceqvigzsrzhpfb4dndoprnpddm-story.html [https://perma.cc/T8EG-2AZK] (reporting death of hundreds of fish due to unintentional release of PFAS-containing firefighting foam into stream).

167. *See* Susan Cosier, *America's Dairyland May Have a PFAS Problem*, NRDC (Oct. 11, 2019), https://www.nrdc.org/stories/americas-dairyland-may-have-pfas-problem [https://perma.cc/8W7K-2G3R].

168. *See* M. Christina Schilling Costello & Linda S. Lee, *Sources, Fate, and Plant Uptake in Agricultural Systems of Per- and Polyfluoroalkyl Substances*, CURRENT POLLUTION REPS. (Dec. 15, 2020), https://link.springer.com/content/pdf/10.1007/s40726-020-00168-y.pdf [https://perma.cc/2ULV-23ZY]; Wenfeng Wang et al., *Uptake and Accumulation of Per- and Polyfluoroalkyl Substances in Plants*, CHEMOSPHERE (Dec. 2020), https://www.sciencedirect.com/science/article/abs/pii/S0045653520317793 [https://perma.cc/6NFX-KZXL].

169. *See* Zhaoyang Liu et al., *Multiple Crop Bioaccumulation and Human Exposure of Perfluoroalkyl Substances Around a Mega Fluorochemical Industrial Park, China: Implication for Planting Optimization and Food Safety*, 127 ENV'T INT'L 671, 682 (2019).

170. *See id.*

171. *See* Costello & Lee, *supra* note 168 (finding stress responses in lab studies but not in field-scale studies).

172. *See* Ariana Figueroa, *A New Target for Federal Action: PFAS-Tainted Food*, E&E NEWS (Oct. 21, 2019), https://www.eenews.net/stories/1061338945 [https://perma.cc/AE9W-37KL]; Wang et al., *supra* note 168.

173. *See* Glüge et al., *supra* note 33, at 2359–68 tbl.4.

II. EXISTING WATER QUALITY REGULATORY SCHEMES

Termed an emerging contaminant because our understanding of them is rapidly expanding, PFAS are largely unregulated.[174] Broadly, federal regulation drives water quality and state agencies enforce it.[175] The government regulates and manages water differently depending on its source and use.[176] Since food and water are primary pathways for PFAS exposure, this Comment focuses on agricultural and drinking water.[177] At the federal level, the EPA, the Food and Drug Administration (FDA), and the U.S. Department of Agriculture (USDA) handle agricultural water;[178] the EPA is almost wholly responsible for drinking water.[179] Efforts to address PFAS contamination have largely targeted drinking water.[180]

Two approaches arise out of the diverse array of states with stakes in the Colorado River: heightened standards (e.g., California) or the bare-minimum (e.g., Arizona). Thus, California and Arizona will be used to represent the spectrum of state-level approaches, recognizing that other states fall somewhere in the middle.[181] The California Water Boards and Arizona

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174. *See* ARIZ. DEP'T OF ENV'T QUALITY, *supra* note 20. This terminology reflects the reactive nature of water quality regulation, since PFAS are far from new.

175. *See Water Quality and Protection*, U.S. GOV'T ACCOUNTABILITY OFF., https://www.gao.gov/water-quality-and-protection [https://perma.cc/7RZQ-JDZ7] (describing several ways in which the EPA works with states to meet water standards).

176. *See Regulatory and Guidance Information by Topic: Water*, EPA, https://www.epa.gov/regulatory-information-topic/regulatory-information-topic-water [https://perma.cc/E5D3-EJSJ].

177. These are both *use* designations, versus *source* designations. *See, e.g.*, *Water-Use Terminology*, USGS, https://www.usgs.gov/mission-areas/water-resources/science/water-use-terminology [https://perma.cc/JB6L-P95B] (describing water-use categories); *Basic Information About Source Water Protection*, EPA, https://www.epa.gov/sourcewaterprotection/basic-information-about-source-water-protection [https://perma.cc/N9LR-S36D] ("Source water refers to sources of water (such as rivers, streams, lakes, reservoirs, springs, and groundwater) . . . .").

178. *See, e.g.*, *Laws and Regulations that Apply to Your Agricultural Operation by Farm Activity*, EPA, https://www.epa.gov/agriculture/laws-and-regulations-apply-your-agricultural-operation-farm-activity [https://perma.cc/QVT8-EAQ4]; *FSMA Proposed Rule on Agricultural Water*, FDA, https://www.fda.gov/food/food-safety-modernization-act-fsma/fsma-proposed-rule-agricultural-water [https://perma.cc/H7MR-LLS3]; *Water and Agriculture*, USDA, https://www.nal.usda.gov/legacy/aglaw/water-and-agriculture [https://perma.cc/729Y-TWB3].

179. *See, e.g.*, *Summary of the Safe Drinking Water Act*, EPA, https://www.epa.gov/laws-regulations/summary-safe-drinking-water-act [https://perma.cc/3FV8-R74J].

180. *See, e.g.*, EPA, EPA PFAS ACTION PLAN: PROGRAM UPDATE 7 (2020) (describing actions to address PFAS contamination under the Safe Drinking Water Act).

181. It is also important to note the role of numerous Native American tribes in the region. Some tribes, including the Navajo Nation, have claimed Treatment as a State (TAS) status, allowing them to impose heightened standards. *Water Quality Standards Regulations: Navajo Nation*, EPA, https://www.epa.gov/wqs-tech/water-quality-standards-regulations-navajo-nation [https://perma.cc/DGZ2-Q4VJ]. In such a circumstance, the federal government is then

Department of Environmental Quality (ADEQ) enforce their respective state's water quality standards.[182]

A. Agricultural Water

Agricultural water can come from any source. The CDC defines it as "water that is used to grow fresh produce and sustain livestock."[183] California's definition focuses on non-recycled water used for irrigation,[184] while Arizona's emphasizes surface water used for "agricultural irrigation" and "livestock watering."[185] Agriculture accounts for roughly 80% of the Colorado River's use, yielding 15% of U.S. crops and 13% of the country's livestock.[186] While the region's eminent concern is having enough water, water quality still matters.[187]

When regulated, agricultural water is treated as a point source. Water for produce and livestock often gets special carve-outs,[188] reflecting both farming's enduring political power[189] and the public's naive notions of

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responsible for enforcement. *See* NAVAJO NATION ENV'T PROT. AGENCY, NAVAJO NATION SURFACE WATER QUALITY STANDARDS 2007, at 9–10 (2007). Thus, such tribal water quality regulation fits the California–Arizona paradigm.

182. *See Division of Water Quality*, CAL. WATER BDS. (June 15, 2021), https://www.waterboards.ca.gov/water_issues/programs/water_quality/ [https://perma.cc/YYP5-43WF]; *Water Quality Division*, ARIZ. DEP'T OF ENV'T QUALITY, https://azdeq.gov/wqd [https://perma.cc/ES2E-KYA4].

183. *Other Uses and Types of Water: Agricultural Water*, CTRS. FOR DISEASE CONTROL & PREVENTION (Oct. 11, 2016), https://www.cdc.gov/healthywater/other/agricultural/ [https://perma.cc/XUP5-8BAN]. Another federal definition, used by an eastern interstate watershed, is "[a] water use associated primarily with the raising of food, fiber or forage crops, trees, flowers, shrubs, turf products, livestock and poultry," as well as "aquaculture." 18 C.F.R. § 806.3.

184. *See* CAL. WATER CODE § 10608.12(a) (West 2021).

185. ARIZ. ADMIN. CODE §§ 18-11-101(2), (3) (2019).

186. Aaron Citron, *The Colorado River Basin Can't Afford To Leave Farmers Out To Dry*, ENV'T DEF. FUND (July 24, 2014), http://blogs.edf.org/growingreturns/2014/07/24/the-colorado-river-basin-cant-afford-to-leave-farmers-out-to-dry/ [https://perma.cc/VHC4-F8H6].

187. *See generally* Colo. State Univ., *How Can Agriculture in the Colorado River Basin Best Address Pressures on Its Water?*, SCIENTIA, http://www.crbagwater.colostate.edu/files/Scientia_Report.pdf#:~:text=For%20the%20past%20seven%20years%2C%20in%20two%20USDA,help%20meet%20increasing%20demands%20for%20Colorado%20River%20water [https://perma.cc/3RN5-57SY]. SCOTT L. MORFORD, SALINITY IN THE COLORADO RIVER BASIN 1–5 (2014).

188. *See* Margot J. Pollans, *Drinking Water Protection and Agricultural Exceptionalism*, 77 OHIO ST. L.J. 1195, 1213–14 (2016).

189. Agribusiness spent over $193 million on political contributions in 2020. *Interest Groups*, OPENSECRETS, https://www.opensecrets.org/industries/ [https://perma.cc/2MAL-TKTV].

food.[190] Generally, we have cared more about what farming adds to water (e.g., pesticides, salinity) than what was in the water when it arrived on the farm.[191] We give little attention to water quality until product recalls alert us to contaminants like E. coli in produce.[192] Federally, a hodge-podge of laws and agency regulations govern agricultural water. As is often the case, California regulates more aggressively—but only marginally so. Arizona is largely in lockstep with the federal government.

1. Federal Regulation

Agricultural water regulation is spread across federal agencies, which complicates the process for regulating new substances, like PFAS. The EPA, FDA, and USDA all get a slice of the pie. The EPA is concerned with preventing water pollution broadly,[193] while the FDA and USDA are more narrowly interested in water to the extent it implicates food.[194] Today, PFAS are unregulated in agricultural water, but there has been a spike in research and information gathering in recent years.[195]

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190. When surveyed, 72% of consumers "kn[ew] nothing or very little about farming or ranching." Farmers would agree: 86% of farmers or ranchers felt that the average consumer knew nothing or little about farming or ranching. U.S. Farmers & Ranchers All., *Nationwide Surveys Reveal Disconnect Between Americans and Their Food*, PR NEWSWIRE (Sept. 22, 2011), https://www.prnewswire.com/news-releases/nationwide-surveys-reveal-disconnect-between-americans-and-their-food-130336143.html [https://perma.cc/RHD9-QUP5].

191. *See, e.g.*, Beyond Pesticides, *Organic Land Management and the Protection of Water Quality*, 33 PESTICIDES & YOU, no. 4, Winter 2013–14, at 11–14; *Water Pollution*, RODALE INST., https://rodaleinstitute.org/why-organic/issues-and-priorities/water-pollution/ [https://perma.cc/24ML-9S9G].

192. These reports often involve crops from Arizona and California. *See, e.g.*, *Food Safety Alert: Outbreak of Salmonella Newport Infections Linked to Onions*, CTRS. FOR DISEASE CONTROL & PREVENTION (Oct. 8, 2020), https://www.cdc.gov/salmonella/newport-07-20/index.html [https://perma.cc/JJ36-BJSC]; *Food Safety Alert: Outbreak of E. coli Infections Linked to Romaine Lettuce*, CTRS. FOR DISEASE CONTROL & PREVENTION (Jan. 15, 2020), https://www.cdc.gov/ecoli/2019/o157h7-11-19/index.html/ [https://perma.cc/PH6L-7TY3].

193. *See Water Topics*, EPA, https://www.epa.gov/environmental-topics/water-topics [https://perma.cc/JP4A-Q2S9].

194. *See, e.g.*, Final Environmental Impact Statement and Record of Decision for the Standards for the Growing, Harvesting, Packing, and Holding of Produce for Human Consumption; Availability, 80 Fed. Reg. 74,670 (Nov. 27, 2015) (to be codified at 21 C.F.R. pt. 112); FDA, *supra* note 29.

195. *See* EPA, *supra* note 180, at 2; *National Priorities: Research on PFAS Impacts in Rural Communities and Agricultural Operations Informational Webinar*, EPA (Dec. 5, 2019), https://www.epa.gov/research-grants/national-priorities-research-pfas-impacts-rural-communities-and-agricultural-0 [https://perma.cc/EU8Y-J25K].

a. The Environmental Protection Agency (EPA)

The EPA is largely concerned with agriculture's potential as a water contaminant and not its immediate impact on food crops and livestock.[196] The Clean Water Act (CWA) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) compel this focus: each regulates agricultural water as a point source for pollutants, such as salts and nitrates.[197]

Congress enacted the CWA "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters."[198] A "national policy,"[199] it hinges on coordination with and between the States.[200] The CWA "encourage[s] the enactment of improved and, so far as practicable, uniform State laws relating to the prevention, reduction, and elimination of pollution" and "encourage[s]" States to enter compacts "for the prevention and control of pollution."[201] It empowers the EPA to enforce its provisions through compliance orders, civil action, and even criminal penalties.[202] In addition to funding research and monitoring, the CWA requires the EPA to develop water quality standards that

> accurately reflect[] the latest scientific knowledge (A) on the kind and extent of all identifiable effects on health and welfare including, but not limited to . . . wildlife, plant life, . . . esthetics, and recreation which may be expected from the presence of pollutants in any body of water, including ground water; (B) on the concentration and dispersal of pollutants, or their byproducts, through biological, physical, and chemical processes; and (C) on the effects of pollutants on biological community diversity, productivity, and stability . . . .[203]

Recognizing that waste disposal is inevitable, the CWA created the National Pollutant Discharge Elimination System (NPDES), which uses a permitting process to regulate pollutants.[204] A NPDES permit-holder must comply with all permit conditions, "take all reasonable steps" to address any

196. *See Water Topics*, *supra* note 193.

197. *See Laws and Regulations that Apply to Your Agricultural Operation by Statute*, EPA, https://www.epa.gov/agriculture/laws-and-regulations-apply-your-agricultural-operation-statute [https://perma.cc/W5JL-KZ2D].

198. 33 U.S.C. § 1251(a).

199. *Id.* § 1251(a)(3)–(7).

200. *See id.* § 1253.

201. *Id.*

202. *Id.* § 1319.

203. *Id.* § 1314(a)(1).

204. *Id.* § 1342.

adverse environmental impacts of noncompliance, and "monitor and report" compliance or noncompliance.[205]

The CWA underregulates agricultural water compared to other uses. It exempts irrigative "return flows" from its definition of a point source and carves out "discharges composed entirely of return flows from irrigated agriculture" from point-source permitting.[206] But courts are closing loopholes. The Ninth Circuit has limited "entirely" to its literal meaning: "wholly, completely, fully";[207] the Sixth Circuit found that NPDES "permitting" applied to pesticide use at, near, or over waters of the United States.[208] It is unclear if the EPA or Congress will affirm this trajectory or reinforce the historically broad exemption.[209]

CERCLA targets hazardous materials and those responsible for their release into the environment.[210] The Act has two primary aims: short-term removal and long-term remediation.[211] When possible, CERCLA holds contaminating parties financially responsible for clean-up efforts.[212] "Hazardous substances" include the CWA's "toxic pollutants" and the Toxic Substance Control Act's "imminently hazardous chemical substance[s] or mixture[s]."[213] The "environment" includes "navigable waters," "ocean

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205. 5 WEST'S FED. ADMIN. PRAC. § 5263 (2021).

206. 33 U.S.C. §§ 1342(*l*)(1), 1362(14). Oil, gas, and mining also gets a limited carve-out, as does "silvicultural activity." *Id.* §§ 1342(l)(2), (3).

207. Pacific Coast Fed'n of Fishermen's Ass'ns v. Glaser, 945 F.3d 1076, 1085 (9th Cir. 2019) (quoting Webster's Dictionary).

208. Nat'l Cotton Council of Am. v. EPA, 553 F.3d 927, 940 (6th Cir. 2009).

209. *See* Norman M. Semanko, *Clean Water Act Case Review:* Glaser *and the Future of the Irrigation Return Flow Exemption*, 63 ADVOCATE 28, 29–30 (2020).

210. *See Superfund: CERCLA Overview*, EPA, https://www.epa.gov/superfund/superfund-cercla-overview [https://perma.cc/VNE6-H9BH].

211. *Id.*

212. *What Is Superfund?*, EPA, https://www.epa.gov/superfund/what-superfund [https://perma.cc/Q2XN-GN9Q].

213. 42 U.S.C. § 9601(14). The Toxic Substances Control Act (TSCA) governs manufacturers, importers, processors, and distributors of toxic chemicals, such as asbestos. *Id.* §§ 2601–2697; *see also Summary of the Toxic Substances Control Act*, EPA, https://www.epa.gov/laws-regulations/summary-toxic-substances-control-act [https://perma.cc/US52-9L5V]. While relevant to point-source regulation of PFAS, the TSCA is not directly applicable to environmental PFAS. 42 U.S.C. §§ 9601(33), 9602(a). In July 2020, the EPA used the TSCA to require notice and review before companies start manufacturing phased-out long-chain PFAS. 40 C.F.R. § 721.25 (2020); *see also Risk Management for Per- and Polyfluoroalkyl Substances (PFAS) Under TSCA*, EPA, https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/risk-management-and-polyfluoroalkyl-substances-pfas [https://perma.cc/VGN4-8SUH]. The new rule also limits the import of certain PFAS-containing products. 40 C.F.R. § 721.25.

waters," and "any other surface water, ground water, [and] drinking water supply."[214] Farms qualify as "onshore facilities."[215]

All farms must notify the National Response Center within twenty-four hours of releasing any hazardous substances that meet or exceed their reportable quantities.[216] Farms with a release deemed to be "an imminent and substantial danger to the public health or welfare" must comply with federal efforts, manage clean-up themselves, or both.[217] That said, "normal" use of fertilizers, use of registered pesticides, federally-permitted releases, and air emissions from animal waste are all exempt from reporting.[218]

There are no federal standards for PFAS in water used for crops and livestock, although the EPA has funded research on PFAS' impact on agricultural operations.[219] Designating PFOA and PFOS as hazardous substances under CERCLA was a key priority of the 2019 PFAS Action Plan, but efforts stalled during the Trump Administration.[220] In 2020, the EPA noted it was "scoping development of draft human health and aquatic life criteria for PFOA and PFOS."[221] A handful of proposed bills would have required that the EPA determine if the CWA should regulate *any* measurable PFAS; a 2019 bill made it to the Senate, and a 2020 bill died in the House.[222]

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214. 42 U.S.C. § 9601(8).

215. *Id.* § 9601(18) (defining as "any facility . . . of any kind located in, on, or under, any land or nonnavigable waters within the United States").

216. *See* 40 C.F.R. § 302.6(a) (2018). *See generally* EPA, QUESTIONS AND ANSWERS ON RELEASE NOTIFICATION REQUIREMENTS AND REPORTABLE QUANTITY ADJUSTMENTS 1 (1995), https://www.epa.gov/sites/production/files/2013-08/documents/release_notification_qa.pdf [https://perma.cc/DUL9-7FAD].

217. 42 U.S.C. § 9604(a)(1); *Laws and Regulations that Apply to Your Agricultural Operation by Statute*, *supra* note 197.

218. *Laws and Regulations that Apply to Your Agricultural Operation by Statute*, *supra* note 197.

219. Press Release, EPA, EPA Awards Nearly $5 Million for New Research on Managing PFAS in Agricultural and Rural Communities (Aug. 20, 2020), https://www.epa.gov/newsreleases/epa-awards-nearly-5-million-new-research-managing-pfas-agricultural-and-rural [https://perma.cc/KA9S-7AJN]; *see also National Priorities: Research on PFAS Impacts in Rural Communities and Agricultural Operations*, EPA, https://www.epa.gov/research-grants/national-priorities-research-pfas-impacts-rural-communities-and-agricultural [https://perma.cc/2L97-7TDS] (Nov. 16, 2021).

220. EPA, EPA 823R18004**,** EPA'S PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) ACTION PLAN 3 tbl.1 (2019), https://www.epa.gov/sites/production/files/2019-02/documents/pfas_action_plan_021319_508compliant_1.pdf [https://perma.cc/2TE5-AFSX]; Lawrence E. Culleen, *Eight Important Updates About Recent PFAS Regulatory Developments*, ARNOLD & PORTER (Feb. 26, 2021), https://www.arnoldporter.com/en/perspectives/publications/2021/02/eight-important-updates-about-pfas [https://perma.cc/5RMQ-6HE8].

221. EPA, *supra* note 180, at 7.

222. PFAS Action Act of 2019, H.R. 535, 116th Cong. (2019); Clean Water Standards for PFAS Act of 2020, H.R. 5539, 116th Cong. (2020).

b. The Food and Drug Administration (FDA)

The FDA regulates more than 80% of the U.S. food supply.[223] Historically, its interest in agricultural water has been limited to microbial contamination of food crops.[224] The FDA sometimes involves itself in water quality regulation, such as with E. coli testing of agricultural water.[225] It defines agricultural water, in part, as water that is intended or likely to contact the harvestable portion of "covered produce" or food-contact surfaces.[226]

PFAS are on the FDA's radar.[227] The FDA coordinated a voluntary phase-out of short-chain PFAS in "food contact applications," such as wrappers and boxes.[228] The FDA selectively tests for PFAS in food, targeting areas with known water contamination, but it has not set agricultural water standards.[229] Recently, PFAS—and PFOS in particular—have been found in dairy milk, tilapia, leafy green vegetables, and more.[230] Despite significant interest in PFAS, the FDA does not clearly communicate toxicity reference values for dietary exposure to PFAS.[231] Instead, it somewhat ambiguously states, "Currently there are five PFAS . . . for which the FDA can assess the potential human health concern for levels found in food."[232] The FDA currently relies

223. Daniela Galarza, *USDA vs. FDA: What's the Difference?*, EATER (Mar. 24, 2017, 1:32 PM), https://www.eater.com/2017/3/24/15041686/fda-usda-difference-regulation [https://perma.cc/X229-G3NV].

224. *See* FDA, *supra* note 29, at 1.

225. 21 C.F.R. § 112.43–.45 (2020); *see also id.*

226. *See* 21 C.F.R. § 112.3 (2021) (defining "agricultural water" as water that "is intended to, or is likely to, contact covered produce or food contact surfaces, including water used in growing activities . . . and in harvesting, packing, and holding activities"). Covered produce is further limited to "the harvestable or harvested part of the crop." *Id.* (defining "covered produce"). These definitions exclude drip irrigation of tree fruit. FDA, *supra* note 29, at 3.

227. *Per- and Polyfluoroalkyl Substances (PFAS)*, FDA (Oct. 18, 2021), https://www.fda.gov/food/chemicals/and-polyfluoroalkyl-substances-pfas [https://perma.cc/6TRH-BSAH].

228. *Authorized Uses of PFAS in Food Contact Applications*, FDA (Oct. 20, 2020), https://www.fda.gov/food/chemicals/authorized-uses-pfas-food-contact-applications [https://perma.cc/KY4T-9ZBU].

229. *Analytical Results of Testing Food for PFAS from Environmental Contamination*, FDA (Dec. 14, 2021), https://www.fda.gov/food/chemicals/analytical-results-testing-food-pfas-environmental-contamination [https://perma.cc/4TE3-496K].

230. Ellen Knickmeyer et al., *FDA: Sampling Finds Toxic Nonstick Compounds in Some Food*, AP (June 3, 2019), https://apnews.com/article/e9c5fa42a1244de48e3edea7a1bb14eb [https://perma.cc/2SHS-D7E7].

231. *See Questions and Answers on PFAS in Food*, FDA (Aug. 26, 2021), https://www.fda.gov/food/chemicals/questions-and-answers-pfas-food [https://perma.cc/XAV5-WDEX].

232. *Testing Food for PFAS and Assessing Dietary Exposure*, FDA, https://www.fda.gov/food/chemical-contaminants-food/testing-food-pfas-and-assessing-dietary-exposure [https://perma.cc/QJU5-5XB6] (Dec. 14, 2021).

on "minimal risk levels" from the Agency for Toxic Substances and Disease Registry for five PFAS, including PFOA and PFOS.[233] As it stands, the FDA is a limited—albeit growing—resource, not a regulator.

c. The U.S. Department of Agriculture (USDA)

The USDA has a broad interest in agricultural water. It is responsible for the food safety of meat, poultry, and "egg products."[234] In this area, the USDA has similar concerns regarding water quality to the FDA.[235] As part of its broader responsibilities, the USDA recognizes that "[a] clean and plentiful water supply is essential," but agriculture itself can impair water quality.[236]

The USDA coordinates with the EPA "to control agricultural nonpoint source pollution for improved water quality."[237] The USDA is encouraged to delegate administration to conservation districts and states but can retain control when necessary.[238] The agency also focuses on watershed health through the Natural Resources Conservation Service.[239] An example is the Colorado River Basin Salinity Control Program, which implements EPA standards by working with water users to measure and mitigate contamination

233. *Id.* For example, the minimal risk level for oral exposure to PFOA is approximately 0.0002 miligrams per day for a 200-pound person. AGENCY FOR TOXIC SUBSTANCES & DISEASE REGISTRY, TOXICOLOGICAL PROFILE FOR PERFLUOROALKYLS 17 (2021), https://www.atsdr.cdc.gov/toxprofiles/tp200.pdf.

234. These categories are oversimplified: for example, game meats like bison and elk fall under the FDA's purview, as do "shell eggs" and wild poultry. *FDA and USDA; Who Regulates What?*, REGISTRAR CORP, https://www.registrarcorp.com/resources/fda-usda-food-regulations/ [https://perma.cc/M2DT-4HWB].

235. *See, e.g.*, DAVID SMITH & SARA LUPTON, AGRIC. RSCH. SERV., U.S. DEP'T OF AGRIC., RESEARCH PROJECT NO. 436180, EVALUATION OF BLOOD AND TISSUE PFAS LEVELS IN UNINTENTIONALLY CONTAMINATED DAIRY ANIMALS (2019) (detailing agency's response to PFAS-exposed dairy cattle in New Mexico).

236. *Water and Agriculture*, NAT'L AGRIC. LIBR., https://www.nal.usda.gov/aglaw/water-and-agriculture [https://perma.cc/ZXT7-8NB].

237. 7 C.F.R. § 634.4(b)(1) (2021).

238. *Id.* § 634.4(b)(4), (5).

239. *Id.* § 634.4(c).

from salinity, pesticides, and nitrates.[240] Farmers and ranchers access USDA services through State Offices and local Service Centers.[241]

The USDA recently began researching PFAS in livestock[242] and has published testing protocols for cows, pigs, and poultry.[243] That said, it has little to implement in the absence of EPA standards and without baseline data.

2. State Regulation

Agricultural water is the lifeblood of the United States. In the Colorado River Basin, upstream contamination has downstream consequences.[244] The Colorado River irrigates 3.2 million acres in the basin and another 2.7 million through exported water.[245] California and Arizona are both agricultural hubs[246] but represent different ends of the regulatory spectrum. Neither state regulates PFAS in agricultural water.

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240. LARA BICKELL, BUREAU OF RECLAMATION, COLORADO RIVER BASIN SALINITY CONTROL PROJECT 3–7 (1999), https://www.usbr.gov/projects/pdf.php?id=96 [https://perma.cc/3GZE-MWU6]; Nat. Res. Conservation Serv., *Colorado River Basin Salinity Control Program*, USDA, https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/alphabetical/?&cid=stelprdb1044198 [https://perma.cc/SGS8-C6VT]; COLO. WATER BASIN SALINITY CONTROL F., 2020 REVIEW: WATER QUALITY STANDARDS FOR SALINITY COLORADO SYSTEM 20 (2020), https://www.coloradoriversalinity.org/docs/2020%20REVIEW%20-%20Final%20w%20appendices.pdf [https://perma.cc/ESE2-YGEA]; *Colorado River Water Quality*, CENT. ARIZ. PROJECT, https://www.cap-az.com/community/sustainability/colorado-river-water-quality/ [https://perma.cc/5TE3-D4RL].

241. *See* Farm Serv. Agency, *State Offices*, USDA, https://www.fsa.usda.gov/state-offices/index [https://perma.cc/56CE-BCN2]; *Service Center Locator*, USDA, https://offices.sc.egov.usda.gov/locator/app [https://perma.cc/76H4-4TRX].

242. SMITH & LUPTON, *supra* note 235.

243. Food Safety & Inspection Serv., Off. of Pub. Health Scis., U.S. Dep't of Agric., Screening, Determination and Confirmation of PFAS by UPLC-MS-MS 1 (2020), https://www.fsis.usda.gov/sites/default/files/media_file/2020-09/clg-pfas-2.02.pdf [https://perma.cc/9JXU-Q6M6].

244. *See, e.g.*, John Gardella, *PFAS Issues in California Compounded by Colorado's PFAS Proliferation*, NAT'L L. REV. (Aug. 14, 2020), https://www.natlawreview.com/article/pfas-issues-california-compounded-colorado-s-pfas-proliferation [https://perma.cc/VTM5-THMH].

245. MICHAEL COHEN ET AL., PAC. INST., WATER TO SUPPLY THE LAND 1 (2013).

246. ARIZ. DEP'T OF AGRIC., GUIDE TO ARIZONA AGRICULTURE 8 (2018), https://agriculture.az.gov/sites/default/files/AZDA_GuideToAZAg-R5.pdf [https://perma.cc/8Q7R-YN3E]; *California's Top 10 Agricultural Commodities*, CAL. DEP'T OF FOOD & AGRIC., https://www.cdfa.ca.gov/Statistics/ [https://perma.cc/W29T-X8X2].

a. California

California's Environmental Protection Agency enforces state and federal water quality standards through its Water Boards.[247] California's Porter-Cologne Water Quality Control Act[248] includes agricultural supply as a "beneficial use" to be protected "against quality degradation."[249] The Water Code does not use the phrase "agricultural water" and instead relies on the beneficial use designation.[250]

Regional programs target salinity and nitrate levels through a "collaborative basin planning effort."[251] The state also uses "agricultural water quality thresholds," derived from a 1985 United Nations report, to set goals for salinity and other chemical substances.[252] The thresholds are applicable to groundwater and surface water used for "agricultural supply."[253]

In practice, California is concerned with agriculture as a point source. Its Irrigated Lands Regulatory Program, which has issued waste discharge requirements or waivers to roughly 40,000 farmers, requires farmers to monitor and mitigate pollutant releases.[254] Unlike the EPA, California regulates irrigation and stormwater runoff, as well as drain flows.[255] The state has rigorous monitoring programs for surface and groundwater.[256]

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247. CAL. WATER CODE § 13100 (West 2021). The Water Boards consist of nine Regional Boards and the State Water Resources Control Board. *Waterboards Map*, CAL. STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/waterboards_map.html [https://perma.cc/SX6M-BSUB].

248. Porter-Cologne Water Quality Control Act, CAL. WATER CODE §§ 13000–16104 (West 2021).

249. WATER § 13050(f).

250. *See* WATER §§ 16100–04 (lacking mention of "agricultural water" throughout).

251. *See, e.g.*, *Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS)*, CENT. VALLEY REG'L WATER QUALITY CONTROL BD., https://www.cvsalinity.org/docs/committee-document/public-education-and-outreach-docs/3607-central-valley-salinity-alternatives-for-long-11-11-16/file.html [https://perma.cc/ERE8-UHMU].

252. STATE WATER RES. CONTROL BD., A COMPILATION OF WATER QUALITY GOALS 16–17 (17th ed. 2016), https://www.waterboards.ca.gov/water_issues/programs/water_quality_goals/docs/wq_goals_text.pdf [https://perma.cc/HMN2-79XT].

253. *Id.* at 27.

254. STATE WATER RES. CONTROL BD., IRRIGATED LANDS REGULATORY PROGRAM 1 (2019), https://www.waterboards.ca.gov/water_issues/programs/agriculture/docs/about_agwaivers.pdf [https://perma.cc/93SL-9RFK].

255. *Id.*

256. *SWAMP–Mission*, STATE WATER RES. CONTROL BD., https://www.waterboards.ca.gov/water_issues/programs/swamp/mission.html [https://perma.cc/QXE8-TTWY] (last updated May 7, 2018); *Groundwater Ambient Monitoring and Assessment Program (GAMA)*, STATE WATER RES. CONTROL BD.,

But agriculture is deeply embedded in the state's economy, generating $47.1 billion in 2015.[257] When coupled with PFAS' relative novelty, it is no surprise that California does not regulate PFAS in agricultural water. And while California has the authority—and willingness—to regulate, drinking water is a more obvious target.

b. Arizona

ADEQ is responsible for administering federal water quality standards.[258] Arizona does not allow permitting of point sources discharging into navigable waters to be more stringent than provided for by the CWA.[259] Because of this, Arizona only regulates agricultural "surface water," which is further narrowed to "navigable waters"—or "waters of the United States," as defined by the CWA.[260] This is a far cry from the wide-ranging definition used in Arizona's water rights scheme: "waters of all sources, flowing in streams, canyons, ravines or other natural channels, or in definite underground channels, whether perennial or intermittent, flood, waste or surplus water, and of lakes, ponds and springs on the surface."[261]

Despite this roadblock, Arizona has written some nuance into agricultural water. State regulation distinguishes agricultural irrigation ("the use of a surface water for crop irrigation") and livestock watering ("the use of a surface water as a water supply for consumption by livestock").[262] Arizona has a promising framework for future regulation, but the state's hands are tied. It is thus unsurprising that Arizona does not regulate PFAS in agricultural water. And much like California, Arizona will be slow to regulate: Agriculture was a $23 billion industry as recently as 2018.[263] In both states, confronting PFAS in drinking water is a more likely first step towards comprehensive regulation.

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https://www.waterboards.ca.gov/gama/ [https://perma.cc/ME4X-S3MT] (last updated Nov. 24, 2021).

257. Todd Manley, *California Agriculture – A State of Abundance*, N. CAL. WATER ASS'N (Aug. 4, 2017), https://norcalwater.org/2017/08/04/california-agriculture-a-state-of-abundance/ [https://perma.cc/YRG4-QVRG].

258. ARIZ. DEP'T OF ENV'T QUALITY, *supra* note 182.

259. ARIZ. REV. STAT. ANN. § 49-203(A)(2) (2021).

260. *Id.* § 49-201(53); ARIZ. ADMIN. CODE § R18-11-102(A); 33 U.S.C. § 1362(7).

261. ARIZ. REV. STAT. ANN. § 45-141(A) (2021).

262. ARIZ. ADMIN. CODE § R18-11-101(2)–(3) (2021).

263. ARIZ. DEP'T OF AGRIC., *supra* note 246, at 13.

B. Drinking Water

Drinking water is almost wholly governed by the Safe Drinking Water Act and analogous state law. Like for agricultural water, the EPA establishes recommended criteria for states to either adopt as is or impose with more rigorous standards.[264] Drinking water's simplified regulatory structure makes it easier to regulate, whether dealing with old or new contaminants. It also makes an easy target for regulation because the benefit is traceable and relatively immediate.[265] Collectively, these factors mean drinking water is often where water quality regulation starts—and stops.

1. Federal Regulation: The Safe Drinking Water Act (SDWA)

The SDWA regulates drinking water as a matter of public health.[266] It requires the EPA to "publish a maximum contaminant level goal and promulgate a national primary drinking water regulation for a contaminant" upon a determination that:

> (i) the contaminant may have an adverse effect on the health of persons; (ii) the contaminant [occurs or is likely to occur] in public water systems with a frequency and at levels of public health concern; and (iii) in the sole judgment of the Administrator, regulation . . . presents a meaningful opportunity for health risk reduction for persons served by public water systems.[267]

The regulations apply to "public water systems."[268] The SDWA also requires the identification of "critical aquifer protection areas" to avoid degradation.[269]

Maximum contaminant levels (MCLs) are set "as close . . . as is feasible" to "the level at which no known or anticipated adverse effects on the health of persons occur and which allows an adequate margin of safety."[270] The EPA can also issue non-enforceable "health advisories," providing notice that a

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264. *Drinking Water Requirements for States and Public Water Systems*, EPA, https://www.epa.gov/dwreginfo/drinking-water-regulations [https://perma.cc/XF5H-FVD4].

265. Conversely, harm is more obvious. Bad-tasting water is blamed on the tap; bad-tasting fruit would never be blamed on the irrigative water. *See National Benefits Analysis for Drinking Water Regulations*, EPA, https://www.epa.gov/sdwa/national-benefits-analysis-drinking-water-regulations [https://perma.cc/K8VL-MQ8P].

266. EPA, UNDERSTANDING THE SAFE DRINKING WATER ACT 1 (2004), https://www.epa.gov/sites/production/files/2015-04/documents/epa816f04030.pdf [https://perma.cc/58RT-GBB5].

267. 42 U.S.C. § 300g-1(b)(1)(A).

268. *Id.* Public water systems either have "at least fifteen service connections" or "regularly serve[ ] at least twenty-five individuals." *Id.* § 300f(4).

269. *Id.* § 300h-6.

270. *Id.* § 300g-1(b)(4)(A), (B).

substance, while unregulated, may adversely affect human health.[271] Health advisories can be set at one-day, ten-day, and lifetime exposure levels.[272] In its early years, the SDWA required the EPA to regulate twenty-five new contaminants every three years.[273] Today, its "risk-based approach" requires regulatory determinations on at least five contaminants every five years.[274]

Historically, the EPA has favored reporting and research over mandatory standards for PFAS.[275] It first flagged PFOA and PFOS in 2009 as contaminants potentially warranting regulation.[276] In 2016, the EPA issued Lifetime Health Advisories (LTHA) for PFOA and PFOS after detecting the pair in twenty-four states' public water supplies.[277] The LTHA recommends a combined concentration of no more than seventy parts per trillion in drinking water,[278] well above the one part per trillion recommended by the non-profit Environmental Working Group.[279] Water providers should notify customers of PFAS contamination above the EPA limit but have no duty to mitigate.[280]

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271. *Id.* § 300g-1(b)(1)(F); *see also Drinking Water Contaminant Human Health Effects Information*, EPA, https://www.epa.gov/sdwa/drinking-water-contaminant-human-health-effects-information [https://perma.cc/8RYQ-G9WT].

272. EPA, 2018 EDITION OF THE DRINKING WATER STANDARDS AND HEALTH ADVISORIES TABLES, at vi (2018), https://www.epa.gov/sites/production/files/2018-03/documents/dwtable2018.pdf [https://perma.cc/4WGY-C48Z].

273. ELENA H. HUMPHREYS & MARY TIEMANN, CONG. RSCH. SERV., RL31243, SAFE DRINKING WATER ACT (SDWA): A SUMMARY OF THE ACT AND ITS MAJOR REQUIREMENTS 2 (2017).

274. *Id.* at 2, 5; Announcement of Preliminary Regulatory Determinations for Contaminants on the Fourth Drinking Water Contaminant Candidate List, 85 Fed. Reg. 14,098 (Mar. 10, 2020) (to be codified at 40 C.F.R. pt. 141).

275. *See generally* EPA, *supra* note 266.

276. MARY TIEMANN & ELENA H. HUMPHREYS, CONG. RSCH. SERV., IF11219, REGULATING DRINKING WATER CONTAMINANTS: EPA PFAS ACTIONS 1 (2020).

277. *Id.*; Lifetime Health Advisories and Health Effects Support Documents for Perfluorooctanoic Acid and Perfluorooctane Sulfonate, 81 Fed. Reg. 33,250 (May 25, 2016) [hereinafter LTHA Notice 2016].

278. LTHA Notice 2016, *supra* note 277, at 33,251. Seventy ppt can be imagined as 3.5 drops of water in an Olympic swimming pool. Ben Fruchey & Nick Tatro, *PFAS Litigation: An Overview of Cases, Claims, Defenses, Verdicts and Settlements*, 36 MICH. DEF. Q. 6, 6 (2019), https://fbmjlaw.com/wp-content/uploads/2020/01/FINAL_184076_MDTC_VOL-36-No-2.pdf [https://perma.cc/SQ87-SH97].

279. Sarah Gibbens, *Toxic 'Forever Chemicals' More Common in Tap Water than Thought, Report Says*, NAT'L GEOGRAPHIC (Jan. 24, 2020), https://www.nationalgeographic.com/science/2020/01/pfas-contamination-safe-drinking-water-study/ [https://perma.cc/H8F2-HDUP].

280. EPA, *supra* note 142, at 2.

The EPA has not yet established LTHA levels for other PFAS.[281] It has listed four alternate PFAS for monitoring, two of which are short-chains.[282] In 2018, it published draft toxicity assessments for the short-chain compounds GenX and PFBS suggesting that GenX was four times—and PFBS 500 times—less toxic than PFOA and PFOS.[283]

In 2019, the EPA identified "key PFAS-related" stakeholder concerns: (1) regulatory uncertainty relating to drinking water; (2) accountability for environmental contamination; (3) guidance for groundwater cleanup actions; (4) understanding of potential human health impacts of novel PFAS; and (5) further information about PFAS newly entering the market.[284] After a decade of research, the EPA proposed formal PFAS regulation in February 2020.[285] On the eve of the Biden administration, the EPA announced its intent to regulate PFOA and PFOS under the SDWA.[286] It also proposed a rule requiring that public water systems monitor twenty-nine other PFAS.[287] In October 2021, the EPA released a PFAS Strategic Roadmap, which promised a proposed drinking water standard for PFOA and PFOS in Fall 2022.[288] The Roadmap also stated the EPA's intent to publish LTHA limits for GenX and PFBS.[289] The final monitoring rule, promised in the Roadmap and published in December 2021, was ground-breaking in its scope: Public water systems will be responsible for monitoring *twenty-nine* short- and long-chain PFAS.[290]

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281. EPA, *supra* note 272, at 6 (reporting standards for PFOA and PFOS but no other PFAS).

282. Revisions to the Unregulated Contaminant Monitoring Regulation (UCMR 3) for Public Water Systems, 77 Fed. Reg. 26,071, 26,075 (May 2, 2012) (to be codified at 40 C.F.R. pt. 141, 142); *see also* EPA, THE THIRD UNREGULATED CONTAMINANT MONITORING RULE (UCMR 3) 2 (2016), https://www.epa.gov/sites/production/files/2016-05/documents/ucmr3-factsheet-list1.pdf [https://perma.cc/W28K-SMVA].

283. *See* EPA, *supra* note 51, at 3.

284. EPA, *supra* note 220, at 3–4 tbl.1.

285. EPA, *supra* note 180, at 7.

286. Announcement of Final Regulatory Determinations for Contaminants on the Fourth Drinking Water Contaminant Candidate List, 86 Fed. Reg. 12,272, 12,272 (Mar. 3, 2021) (to be codified at 40 C.F.R. pt. 141).

287. Revisions to the Unregulated Contaminant Monitoring Rule (UCMR 5) for Public Water Systems and Announcement of Public Meeting, 86 Fed. Reg. 13,846, 13,486 (Mar. 11, 2021) (to be codified at 40 C.F.R. pt. 141).

288. EPA, *supra* note 17, at 12–13.

289. *Id.*

290. Revisions to the Unregulated Contaminant Monitoring Rule (UCMR 5) for Public Water Systems and Announcement of Public Meetings, 86 Fed. Reg. 73131, 73132 (Dec. 27, 2021) (to be codified at 40 C.F.R. pt. 141).

2. State Regulation

California and Arizona do not uniquely represent the Colorado River Basin's interests in drinking water, unlike with agricultural water. Still, their role as regulatory opposites helps establish a baseline for the region.

a. California—"[T]hat the water . . . shall at all times be pure, wholesome, and potable"[291]

California adopted its own Safe Drinking Water Act "to improve upon the minimum requirements" of the SDWA and "establish a program . . . that is more protective of public health."[292] There are a handful of chemicals—primarily herbicides—that California sets MCLs for but the federal government does not regulate.[293] California uses notification and response levels for chemicals without MCLs, serving as "precautionary measures."[294] Concentrations above the notification level trigger limited disclosure requirements;[295] the state recommends removing a source from service when contaminants exceed the response level.[296] If a public water system identifies contamination during state-ordered testing, California will force it to take the source offline or provide public notice within 30 days.[297]

California has no mandatory PFAS standards.[298] However, California set its notification limits at the lowest reliably detectable level for PFOS and PFOA: 6.5 and 5.1 ppt, respectively.[299] In February 2020, the state lowered

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291. CAL. HEALTH & SAFETY CODE § 116270(e) (West 2021).

292. *Id.* § 116270(f).

293. CAL. WATER BDS., MAXIMUM CONTAMINANT LEVELS AND REGULATORY DATES FOR DRINKING WATER: U.S. EPA VS CALIFORNIA 3 (2018), https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/ccr/mcls_epa_vs_dwp.pdf [https://perma.cc/S23M-5C63] (reporting molinate MCL for California but not EPA).

294. CAL. HEALTH & SAFETY CODE § 116455(b)(3), (4) (West 2021).

295. Water systems must report the contamination to relevant governing bodies but have no duty to inform their consumers. *Drinking Water Notification Levels*, CAL. WATER BDS., https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/NotificationLevels.html [https://perma.cc/5J24-RHPN].

296. *Id.*

297. CAL. HEALTH & SAFETY CODE § 116378(c)(3) (West 2021).

298. *See, e.g.*, Rachel Becker, *Forever Chemicals: California Unveils Health Goals for Contaminated Drinking Water*, CAL MATTERS (July 21, 2021), https://calmatters.org/environment/2021/07/california-goals-contaminated-drinking-water/ [https://perma.cc/J9C5-PT89] (discussing proposal to develop new health limits because of lack of enforceable state standards).

299. *Perfluorooctanoic Acid (PFOA) and Perfluorooctanesulfonic Acid (PFOS)*, CAL. WATER BDS., https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/PFOA_PFOS.html

its response levels to 40 ppt for PFOS and 10 ppt for PFOA.[300] Previously, the response level matched the federal LTHA, 70 ppt for PFOS and PFOA combined.[301] And in July 2021, California proposed new Public Health Goals (PHGs), which are definitionally similar to MCLs, for PFOS and PFOA.[302] Both levels—1 ppt for PFOS and 0.007 ppt for PFOA—are a fraction of their notification and response levels.[303]

While focusing on PFOS and PFOA, the State Water Board has recently broadened its purview, albeit slightly, to include PFBS.[304] In March 2021, the Division of Drinking Water adopted a notification limit of 0.5 parts per billion (ppb) and response limit of 5 ppb for PFBS.[305] These limits, which allow higher concentrations of PFBS without being wholly unconcerned, are

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[https://perma.cc/2ANX-HCBA]. As an example, a public water system that detects 10 ppt PFOS must *notify* state regulators and is advised to inform its customers.

300. Media Release, Cal. Water Bds., Response Levels Lowered for Water Systems Statewide as PFAS Investigation Continues (Feb. 6, 2020), https://www.waterboards.ca.gov/press_room/press_releases/2020/pr02062020_pfoa_pfos_response_levels.pdf [https://perma.cc/J26D-JKJN]. As an example, a public water system detecting 50 ppt PFOS must *respond* by (1) taking the contaminated source out of service or (2) providing public notice.

301. *Id.*

302. Announcement of Availability of a Draft Technical Support Document for Proposed Public Health Goals for Perfluorooctanoic Acid and Perfluorooctane Sulfonic Acid in Drinking Water, 31-Z Cal. Regulatory Notice Reg. 985, 985 (July 30, 2021) ("A PHG is the level of a drinking water contaminant at which adverse health effects are not expected to occur from a lifetime of exposure."). While PHGs are not regulatory standards, drinking water standards must be set as close as is "economically and technologically feasible" to the PHG. CAL. HEALTH & SAFETY CODE § 116365 (West 2021). *See generally Guide to Public Health Goals for Chemicals in Drinking Water*, CAL. OFF. OF ENV'T HEALTH HAZARD ASSESSMENT (Feb. 1, 2015), https://oehha.ca.gov/water/guide-public-health-goals-chemicals-drinking-water [https://perma.cc/R36R-ZRRQ].

303. Announcement of Availability of a Draft Technical Support Document for Proposed Public Health Goals for Perfluorooctanoic Acid and Perfluorooctane Sulfonic Acid in Drinking Water, 31-Z Cal. Regulatory Notice Reg. at 985.

304. *See* DARRIN POLHEMUS, CAL. WATER BDS., PROPOSED NOTIFICATION LEVEL ISSUANCE 2 (2021), https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/notificationlevels/pfbs_nl_issuance%20_January%202021_proposed.pdf [https://perma.cc/94XX-X6GX].

305. *Drinking Water Notification Levels*, *supra* note 295. *See generally* OFF. OF ENV'T HEALTH HAZARD ASSESSMENT, NOTIFICATION LEVEL RECOMMENDATION: PERFLUOROBUTANE SULFONIC ACID IN DRINKING WATER (2021), https://oehha.ca.gov/media/downloads/water/chemicals/nl/pfbsnl121820.pdf [https://perma.cc/D979-9J6N] (explaining decision to recommend a 0.5 ppb notification level). Five ppb is equal to 5,000 ppt.

consistent with the idea that short-chain PFAS may be less toxic but are far from innocuous.[306]

b. Arizona—"[T]hat all potable water . . . is free from unwholesome, poisonous, deleterious or other foreign substances and filth or disease causing substances or organisms"[307]

ADEQ develops rules that comply with the SDWA[308] and consults with the Department of Health Services to set "minimum standards for . . . [c]hemicals . . . that come into contact with drinking water."[309] ADEQ acts primarily as an enforcer of the SDWA but does have the right to adopt and build upon the federal standard.[310] Thus, ADEQ uses the SDWA's MCL and health advisory scheme.[311]

There are no mandatory limits on PFAS in drinking water in Arizona.[312] Arizona's Department of Health Services recommends using an alternative source for humans, pets, and livestock if tap water contains more than 70 ppt PFAS.[313] Using an EPA grant, ADEQ sampled 109 wells from sixty-eight public water systems and found detectable amounts of PFOA, PFOS, or both, in twenty wells.[314] The report emphasized that "ADEQ's first priority is to limit exposure through drinking water" and called on the EPA to "[q]uickly and efficiently establish a Maximum Contaminate Level" for PFOA and PFOS.[315] ADEQ did not commit to regulation but noted it was "considering . . . [p]articipat[ing] in the potentially changing regulatory landscape for PFOA/PFOS" and other PFAS.[316]

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306. *Hearing*, *supra* note 51, at 50 (statement of Dr. Jamie C. DeWitt, Associate Professor, East Carolina University); *see* OFF. OF ENV'T HEALTH HAZARD ASSESSMENT, *supra* note 305, at 2.

307. ARIZ. REV. STAT. ANN. § 49-351(A) (2021).

308. *Id.* § 49-353(A)(2)(a).

309. *Id.* § 49-353.01(A)(2), (E)

310. *See, e.g.*, *Drinking Water in Arizona*, ARIZ. DEP'T OF ENV'T QUALITY, https://www.azdeq.gov/node/4411 [https://perma.cc/PSS7-Z7RV]; 4 Ariz. Admin. Reg. 2027–33, (July 31, 1998) (showing how ADEQ modified standards to stay in lockstep with EPA).

311. ARIZ. ADMIN. CODE §§ R18-4-104, -108, -109 (2021).

312. *PFAS (Per- and Polyfluoroalkyl Substances)*, ARIZ. DEP'T OF HEALTH SERVS., https://azdhs.gov/preparedness/epidemiology-disease-control/environmental-health/environmental-public-health-tracking/index.php#pfas [https://perma.cc/W6MM-J7UK].

313. This is an example of building on the federal standard by applying the LTHA level for PFOA and PFOS across the "many different chemicals in the PFAS family." *Id.*

314. ARIZ. DEP'T OF ENV'T QUALITY, ARIZONA'S PUBLIC WATER SYSTEM SCREENING FOR PERFLUOROOCTANOIC ACID (PFOA) AND PERFLUOROOCTANE SULFONATE (PFOS) FINAL REPORT 4 (2018), https://static.azdeq.gov/wqd/reports/pfoapfosepareport_final.pdf [https://perma.cc/X24Q-QKR3].

315. *Id.* at 7.

316. *Id.*

With the EPA on the cusp of formally regulating PFOS and PFOA in drinking water, both California and Arizona must prepare to implement mandated standards. Such a shift will take considerable time and resources.[317] Other federal agencies are likely to follow suit, as the SDWA triggers a domino effect. Mandatory standards will also lead to increased litigation, now driven by SDWA violations.

III. LITIGATION

PFAS litigation has evolved from targeted attacks on chemical manufacturers to a broader effort against PFAS nearly anywhere in their lifecycle.[318] In the absence of a clear regulatory framework, litigation involves a patchwork of legal claims and parties.[319] Litigation first targeted manufacturers of PFOA and PFOS, like DuPont and 3M.[320] Perhaps because attacks on PFAS manufacturers were yielding little more than flashy settlements, litigation evolved to target PFAS *users*.[321]

The shift to downstream users has broadened the geography of these suits.[322] Colorado River Basin states lack PFAS manufacturing plants but have been large users of AFFFs, a type of fire-fighting foams favored by the aviation industry.[323] Air Force bases and airports are inevitable targets of

317. *See* Letter from G. Tracy Mehan, III, Exec. Dir. for Gov't Affs., Am. Water Works Ass'n, to Lillia Ledezma, Cong. Budget Off. 2 (Aug. 8, 2019), https://www.awwa.org/Portals/0/AWWA/ETS/Resources/AWWAInformationforCBOforPFAS TreatmentCosts.pdf [https://perma.cc/H469-GKTF] (arguing that implementing MCLs for PFOA and PFOS could cost water systems $1.3 billion annually).

318. Jane C. Luxton & William J. Walsh, *The 2020 Outlook for "PFAS" Chemical Litigation: An Expanding Target Zone*, WASH. LEGAL FOUND. (Jan. 31, 2020), https://www.wlf.org/2020/01/31/publishing/the-2020-outlook-for-pfas-chemical-litigation-an-expanding-target-zone/ [https://perma.cc/6Z6L-EZCQ].

319. Fruchey & Tatro, *supra* note 278, at 6. *See generally* Michael Walsh & Patrick Larkin, *PFAS: Ubiquitous and Persistent Chemicals: Assessing Liability and Allocating Risk; Applying Lessons Learned in Industry-Wide Litigation*, 49 TEX. ENV'T L.J. 231 (2019) (discussing legal theories behind PFAS litigation).

320. Luxton & Walsh, *supra* note 318.

321. *Id.*

322. *Id.* (discussing states with past or pending PFAS litigation).

323. *PFAS Contamination in the U.S.*, ENV'T WORKING GRP. (Oct. 4, 2021), https://www.ewg.org/interactive-maps/pfas_contamination/map/ [https://perma.cc/5T24-RADT] (showing interactive map of domestic PFAS contamination); *see* Grace Hood, *Colorado Fire Departments Are Switching to a New PFAS Firefighting Foam, But Concerns Linger*, CPR NEWS (Jan. 17, 2020), https://www.cpr.org/2020/01/17/colorado-fire-departments-are-switching-to-a-new-pfas-firefighting-foam-but-concerns-linger/ [https://perma.cc/NW3X-U3NF].

Western PFAS litigation, and contentious stand-offs between state interests and the military are brewing.[324]

A. Manufacturer Liability: Overview of Legal Theories and Parties

Early PFAS litigation targeted DuPont and 3M.[325] Private plaintiffs began suing DuPont in 2001; the State of Minnesota was the first to sue 3M in 2010.[326] Across the board, DuPont and 3M have settled without findings of fault.[327] DuPont has been particularly successful in shielding itself financially through its wholesale spin-off of the PFAS production sector.[328]

The 2001 DuPont suit, *Leach v. E.I. DuPont de Nemours & Co.*, and the 2011 3M suit, *Minnesota v. 3M*, are emblematic of private plaintiff and government-led suits, respectively.[329] *Leach* relied primarily on tort claims while also arguing that DuPont violated state consumer protection laws.[330] *Minnesota* used both tort claims and the state's version of CERCLA.[331]

1. Leach-ing

Memorialized in the 2019 film *Dark Waters*, starring Mark Ruffalo as the corporate sellout turned public interest lawyer, *Leach* involved DuPont's Washington Works plant in West Virginia.[332] The plant had used PFOA since the 1950s, and DuPont recognized water contamination as early as 1984.[333] In 1998, a cattle rancher sued DuPont over water pollution from a private

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324. *See, e.g.*, Kendra Chamberlain, *2019 Top Stories #2: State, Air Force Battle Over PFAS Clean Up*, NM POLITICAL REPORT (Dec. 30, 2019), https://nmpoliticalreport.com/2019/12/30/2019-top-stories-2-state-air-force-battle-over-pfas-clean-up/ [https://perma.cc/8PB9-7ZRR].

325. Luxton & Walsh, *supra* note 318.

326. *3M Lawsuit*, OFF. OF MINN. ATT'Y GEN., https://www.ag.state.mn.us/Office/Cases/3M/default.asp [https://perma.cc/7REP-Y8RD].

327. Luxton & Walsh, *supra* note 318.

328. Gretchen Morgenson, *How DuPont May Avoid Paying To Clean Up a Toxic 'Forever Chemical'*, NBC NEWS (Mar. 1, 2020, 4:10 AM), https://www.nbcnews.com/health/cancer/how-dupont-may-avoid-paying-clean-toxic-forever-chemical-n1138766 [https://perma.cc/S3UY-94Q2].

329. Fruchey & Tatro, *supra* note 278, at 7.

330. *Id.*

331. *Id.* at 9.

332. Alejandro de la Garza, Dark Waters *Tells the True Story of the Lawyer Who Took DuPont to Court and Won. But Rob Bilott's Fight Is Far from Over*, TIME (Nov. 25, 2019, 12:03 PM), https://time.com/5737451/dark-waters-true-story-rob-bilott/ [https://perma.cc/AN4W-YMBX].

333. PFAS Project Lab, *Parkersburg, West Virginia*, NE. UNIV., https://pfasproject.com/parkersburg-west-virginia/ [https://perma.cc/VD56-AKME].

landfill adjacent to his property.[334] He knew something was killing his cattle—and turning their internal organs neon green—but did not know what.[335] While combing through discovery, the rancher and his attorney, Rob Bilott, learned about PFOA.[336] The cattle case ended with a sealed settlement, but Bilott launched a class action and reported his findings to the EPA.[337]

Led by "Good God, Joe" Kiger,[338] the class included almost 80,000 individuals who had consumed PFOA-contaminated drinking water for at least a year.[339] The complaint raised a litany of legal arguments including breach of warranty, unfair and deceptive trade practices, negligence, nuisance, trespass, and battery.[340] It sought "declaratory, injunctive, equitable relief, compensatory and punitive damages, including medical monitoring" because of DuPont's release of "C-8," an early term for PFOA.[341]

DuPont settled in November 2004.[342] The initial settlement was around $100 million, including legal fees, and required DuPont to improve its water treatment technology.[343] Most importantly, the settlement required DuPont to fund a health study into the health effects of PFOA.[344] If the study found adverse effects, individuals could sue for personal injury.[345] The initial settlement ultimately gave $400 to all study participants; 80% of the surrounding community participated.[346]

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334. Sharon Kelly, *Teflon's Toxic Legacy*, EARTH ISLAND J. (2016), https://www.earthisland.org/journal/index.php/magazine/entry/teflons_toxic_legacy/ [https://perma.cc/F262-FSXJ].

335. *Id.*

336. PFAS Project Lab, *supra* note 333.

337. Kelly, *supra* note 334.

338. *See supra* notes 1–11 and accompanying text.

339. Order Approving Final Settlement at 5, Leach v. E.I. DuPont de Nemours & Co., No. 01-C-608 (W. Va. Cir. Ct. Feb. 28, 2005), https://www.hpcbd.com/dupont/Final-Order-Approving-Settlement.pdf [https://perma.cc/QBD6-JN8Z].

340. Amended Class Action Complaint at 9–17, Leach v. E.I. DuPont de Nemours & Co., No. 01-C-2518 (W. Va. Cir. Ct. 2001); *see also* W. VA. CODE §§ 46A-6-101, 102 (2021).

341. Amended Class Action Complaint, *supra* note 340, at 1–2. PFOA is called C-8 because it has eight carbons, but this term is imprecise because so do other PFAS (e.g., PFOS). Sharon Lerner, *The Teflon Toxin*, INTERCEPT (Aug. 11, 2015, 3:35 PM), https://theintercept.com/2015/08/11/dupont-chemistry-deception/ [https://perma.cc/253R-CXDV].

342. Class Action Settlement Agreement at 13, Leach v. E.I. DuPont de Nemours & Co., No. 01-C-608 (W. Va. Cir. Ct. Nov. 17, 2004), https://www.hpcbd.com/dupont/Settlement-Agreement.pdf [https://perma.cc/74ZV-G7YH].

343. *See id.* at 13, 20–21; Michael Janofsky, *Settlement in DuPont Water Suit*, N.Y. TIMES (Sept. 10, 2004), https://www.nytimes.com/2004/09/10/business/settlement-in-dupont-water-suit.html [https://perma.cc/2KHT-KZRW].

344. Class Action Settlement Agreement, *supra* note 342, at 13, 22–27.

345. *Id.* at 9–10. By then, DuPont was also facing down the EPA. *See supra* notes 61–62 and accompanying text.

346. Kelly, *supra* note 334.

Seven years later, the science panel linked PFOA to several health conditions—even at low exposure levels.[347] In 2015, a jury awarded $1.6 million to the first individual plaintiff, who suffered from kidney cancer.[348] Soon after, another two plaintiffs received punitive damages; DuPont and Chemours settled the remaining personal injury claims for $670 million.[349] The favorable outcome for plaintiffs spurred suits in other areas with chemical manufacturing plants.[350] Even before the study concluded, the *Leach* settlement opened the door for PFAS litigation.

2. *Minnesota v. 3M*

In between the *Leach* class-action settlement and the subsequent $670 million personal injury settlement, the State of Minnesota sued 3M for PFAS contamination in wastewater. 3M manufactured Scotchgard in the Twin Cities area and dumped waste in nearby landfills.[351] Alleging harm to natural resources and drinking water, the state sought money damages for trespass, nuisance, negligence, and its version of CERCLA.[352] In 2018, 3M settled for $850 million, over seven years after the suit began.[353] Around $700 million is

347. Fruchey & Tatro, *supra* note 278, at 8.

348. *Id.*

349. *Id.* Chemours sued DuPont for being "systematically and spectacularly wrong" about the company's environmental liability exposure, but arbitration and indemnification clauses in the separation agreement posed roadblocks. Randall Chase, *Chemours Says DuPont Lowballed Environmental Liabilities*, AP (June 28, 2019), https://apnews.com/article/4e77366b4bcd4fef8d0da759d02aaf05; Jef Feeley & Josh Fineman, *Chemours Lawsuit Over Liability from DuPont Spinoff Tossed*, BLOOMBERG (Mar. 30, 2020, 2:47 PM), https://www.bloomberg.com/news/articles/2020-03-30/chemours-lawsuit-over-liability-from-dupont-spinoff-tossed. Nevertheless, Chemours, DuPont, and the agricultural products spin-off Corteva agreed to split legacy liabilities up to $4 billion in early 2021. Randall Chase, *DuPont, Chemours Reach Pact Over Liability for "Forever Chemicals" PFAs Pollution*, INS. J. (Jan. 25, 2021), https://www.insurancejournal.com/news/national/2021/01/25/598558.htm [https://perma.cc/MSA8-JAYT].

350. Fruchey & Tatro, *supra* note 278, at 8.

351. Jennifer Bjorhus, *$700 Million Plan Unveiled To Deal with 'Forever Chemicals' in East Metro Drinking Water*, STAR TRIB. (Sept. 11, 2020, 9:53 AM), https://www.startribune.com/700-million-plan-unveiled-to-deal-with-forever-chemicals-in-east-metro-drinking-water/572376062/ [https://perma.cc/7FGY-BPD9].

352. Fruchey & Tatro, *supra* note 278, at 9–10.

353. *Home Page*, MINN. 3M PFC SETTLEMENT, https://3msettlement.state.mn.us/ [https://perma.cc/5VBG-AHK4]; *3M Lawsuit*, *supra* note 326.

intended for clean-up and restoration, but the projects will likely cost much more.[354] As of late 2020, neighboring residents still relied on bottled water.[355]

Leach and *Minnesota* are foundational cases but reflect a bygone era of PFAS litigation. 3M and DuPont/Chemours have proven costly—and formidable—opponents. The *Leach* class fared well financially—at the cost of their health. Without Chemours dragging DuPont through arbitration, DuPont would have escaped all so-called "legacy liabilities."[356] And the clean-up process in Minnesota has been more costly than anyone could have imagined. At best, PFAS litigation targeting manufacturers has brought financial resources to the affected areas. But its compound- and region-specific impacts allow multibillion dollar chemical companies to bury the past by pivoting to "new and improved" short-chain alternatives.[357]

B. Western Litigation

As suits against 3M and DuPont turned out to be more bark than bite, PFAS litigation shifted to downstream users.[358] Today, PFAS suits are no longer isolated to the east coast, where manufacturing occurred.[359] Instead, suits target downstream users.[360] Military bases and airports started using AFFFs as firefighting agents in the 1960s, a use that has been tied to at least 401 sites with actual or likely PFAS contamination in groundwater.[361] The Department of Defense (DOD) stopped using AFFFs for "land-based . . . training, testing and maintenance" in 2016, although the foams are still used "in emergencies to save lives," in which case the release is treated as a spill under CERCLA.[362]

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354. Jennifer Bjorhus, *Cleanup of PFAS 'Forever Chemicals' Could Cost up to $1.2 Billion, Exceed 3M Settlement*, STAR TRIB. (Feb. 27, 2020, 9:26 AM), https://www.startribune.com/minnesota-estimates-cost-of-projects-to-treat-drinking-water-under-3m-settlement/568226032/ [https://perma.cc/5V93-G766].

355. Bjorhus, *supra* note 351.

356. *See* Chase, *supra* note 349.

357. *See* Jennifer Bjorhus, *Investigation Targets Discharges of Next-Generation 'Forever Chemicals' from 3M's Cottage Grove Plant*, STAR TRIB. (Dec. 18, 2020, 12:22 AM), https://www.startribune.com/investigation-targets-discharges-of-next-generation-forever-chemicals-from-3m-s-cottage-grove-plant/573421701/ [https://perma.cc/KRK5-ASGJ].

358. Luxton & Walsh, *supra* note 318.

359. *Id.*

360. *Id.*

361. Miranda Paley, *DOD Moving Forward with Task Force To Address PFAS*, U.S. DEP'T OF DEF. (Aug. 9, 2019), https://www.defense.gov/Explore/News/Article/Article/1930618/dod-moving-forward-with-task-force-to-address-pfas/ [https://perma.cc/33EN-YLG2].

362. *Id.*

AFFFs are a key point-source for PFAS in the West.[363] The Colorado River Basin states have a particularly strong military presence and, correspondingly, PFAS contamination.[364] Arizona has banned the use of AFFFs for training and testing purposes.[365] California and Colorado have banned both the use and sale of PFAS-containing firefighting foams.[366] Unfortunately, limiting use is too little, too late when dealing with a "forever chemical."[367] AFFF litigation has exploded in recent years, taking two forms: products liability suits against manufacturers and environmental clean-up suits against the military.[368] Basin states are joining the fray.[369]

1. Multidistrict AFFF Litigation

There were seventy-five AFFF product-liability cases when the Judicial Panel on Multidistrict Litigation elected to consolidate and transfer them to the District of South Carolina in 2018;[370] there are now upwards of 500.[371] Once again, 3M and DuPont/Chemours are defendants—this time, joined by firefighting foam manufacturers.[372] The suits generally allege that the defendants developed and marketed AFFFs knowing they would contaminate

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363. *See, e.g.*, *PFAS Resources*, ARIZ. DEP'T OF ENV'T QUALITY, http://azdeq.gov/pfas-resources [https://perma.cc/54CA-8A6G].

364. *PFAS Contamination in the U.S.*, *supra* note 323.

365. ARIZ. REV. STAT. ANN. § 36-1696 (2019).

366. Monica Amarelo, *California Law Bans Toxic PFAS from Firefighting Foam*, ENV'T WORKING GRP. (Sept. 29, 2020), https://www.ewg.org/release/california-law-bans-toxic-pfas-firefighting-foam [https://perma.cc/JM9T-WE86]; Andy Koen, *Firefighting Foam Ban Signed by Governor*, KOAA NEWS5 (June 3, 2019, 7:17 PM), https://www.koaa.com/news/2019/06/03/firefighting-foam-ban-signed-by-governor/ [https://perma.cc/5EPL-YJZU].

367. In early 2021, Luke Air Force Base reported excessive PFAS levels in nearby wells and began distributing bottled water; within a month, the Air Force had delivered over 21,000 gallons to 4,000 residents. Haleigh Kochanski, *Officials Grill Water Utility over Response to Earlier Luke AFB Spill*, CRONKITE NEWS (Mar. 3, 2021), https://cronkitenews.azpbs.org/2021/03/03/officials-grill-water-utility-over-response-to-earlier-luke-afb-spill/ [https://perma.cc/KP9P-9NTT]. Elevated PFAS levels were first found in nearby water in 2016—shortly after the EPA issued a lifetime health advisory for the chemicals—but minimal action was taken. *Id.* When probed about years of inaction, an affected utility's CFO deflected: "We are not chemists, we're not doctors, we follow the standards that are provided by the EPA, ADEQ . . . and Maricopa County." *Id.*

368. Luxton & Walsh, *supra* note 318 (providing overview of multidistrict litigation).

369. *See, e.g.*, *PFAS in New Mexico*, N.M. ENV'T DEP'T, https://www.env.nm.gov/pfas/main/ [https://perma.cc/MNY7-SZ7R].

370. *In re* Aqueous Film-Forming Foams Prods. Liab. Litig., 357 F. Supp. 3d 1391 (J.P.M.L. 2018) (MDL No. 2873).

371. *See Introduction: Aqueous Film-Forming Foams (AFFF) Products Liability Litigation*, U.S. DIST. CT., https://www.scd.uscourts.gov/mdl-2873/index.asp [https://perma.cc/8VUF-SDKH].

372. *See In re Aqueous Film-Forming Foams Prods. Liab. Litig.*, 357 F. Supp. 3d at 1393.

surface and groundwater, causing adverse health effects.[373] Even airport districts have joined, perhaps anticipating their own liability.[374] A suit by the City of Tucson, Arizona, seeking remediation is also part of the multi-district litigation.[375] Discovery is still ongoing.[376] In early 2021, a firefighting foam company was the first to settle: $17.5 million "to make this situation right."[377]

2. Suing the U.S. Military: A Workaround?

State and local governments can also sue end users.[378] That said, such suits are often against the DOD, which poses unique challenges.[379] Another risk is that such suits still may be subsumed by the South Carolina multi-district litigation.[380] This scenario is playing out in New Mexico where the state's Environmental Department (NMED) is seeking declaratory and injunctive relief in federal court against the Cannon Air Force Base.[381] NMED alleges that the base has contaminated the local water supply, including the Ogallala

373. *Id.* at 1394.

374. *See* Complaint at 2–3, Monterey Peninsula Airport Dist. v. 3M Co., No. 2:20-CV-3490 (D.S.C. Oct. 1, 2020).

375. Joe Ferguson, *Tucson, Marana Sue 3M, 4 Other Companies over Water Contaminants*, ARIZ. DAILY STAR (Jan. 10, 2020), https://tucson.com/news/local/tucson-marana-sue-3m-4-other-companies-over-water-contaminants/article_5437e88d-aa62-575c-b398-20911a46d7d6.html [https://perma.cc/U3WR-FCHJ]; Exhibit A to Notice of Removal at 6-41, City of Tucson v. 3M Co., No. 2:19-CV-00087 (D.S.C. Dec. 21, 2018), ECF No. 1-1.

376. *Introduction: Aqueous Film-Forming Foams (AFFF) Products Liability Litigation*, *supra* note 371; *Current Developments: Aqueous Film-Forming Foams (AFFF) Products Liability Litigation*, U.S. DIST. CT., https://www.scd.uscourts.gov/mdl-2873/current.asp [https://perma.cc/4Q58-TD6Y].

377. Laura Schulte, *Tyco Fire Products Settles Class Action Lawsuit with over 270 Households in Peshtigo*, MILWAUKEE J. SENTINEL (Jan. 7, 2021), https://www.jsonline.com/story/news/local/wisconsin/2021/01/07/tyco-fire-products-settles-class-action-lawsuit-peshtigo/6569072002/ [https://perma.cc/8Z74-4J5J].

378. *See, e.g.*, David D. Cooke & Kamran Javandel, *Calif. Water Utility Sues Feds for $1.3M Water Treatment Cost*, ALLEN MATKINS (Jan. 21, 2020), https://www.allenmatkins.com/real-ideas/calif-water-utility-sues-feds-for-dollar13m-water-treatment-cost.html [https://perma.cc/FC8T-3WEM].

379. *See* Kendra Chamberlain, *New Mexico Joins Multidistrict Litigation Against Firefighting Foam Manufactures for PFAS Contamination*, NM POL. REP. (July 16, 2020), https://nmpoliticalreport.com/2020/07/16/new-mexico-joins-multidistrict-litigation-against-firefighting-foam-manufacturers-for-pfas-contamination/ [https://perma.cc/B8JK-GXJH].

380. *See generally* Catherine R. Borden et al., *Centripetal Forces: Multidistrict Litigation and Its Parts*, 75 LA. L. REV. 425 (2014) (discussing process for consolidating "tag-along cases").

381. Chamberlain, *supra* note 379.

Aquifer,[382] through decades of AFFF use.[383] In 2020, the suit became part of the MDL, even though it targeted the Air Force Base rather than AFFF manufacturers.[384] The state was denied a preliminary injunction and must wait for the MDL to run its course.[385]

As the director of NMED's resource protection division noted, state agencies are limited by the lack of mandatory standards: "We can't take action against an entity that is proven to contaminate the environment above [the health advisory] levels."[386] A mandatory PFAS standard might have avoided this court battle entirely.[387] In the meantime, dairy farmers are forced either to dump entire inventories or invest time and money on private testing in order to avoid sending contaminated milk to market.[388]

IV. ANALYSIS

After decades of being on—and off—the market, PFOS and PFOA are finally on the cusp of being regulated under the Safe Drinking Water Act.[389] The EPA also plans to "fast track" regulating problematic PFAS in the

382. Jennifer M. Latzke, *Clovis Dairy's Well Contamination Has Farmers Across the Ogallala Concerned*, HIGH PLAINS J. (Dec. 29, 2019), https://www.hpj.com/latzke/clovis-dairy-s-well-contamination-has-farmers-across-the-ogallala-concerned/article_577d26be-3c47-11e9-a37c-f73b271f577e.html [https://perma.cc/NTB3-9BH5]; *see also* Christopher Collins, *Nearly 500,000 Texans Live in Communities with Contaminated Groundwater. Lawmakers Aren't Doing Much About It.*, TEX. OBSERVER (June 19, 2019, 1:02 PM), https://www.texasobserver.org/nearly-500000-texans-live-in-communities-with-contaminated-groundwater-their-lawmakers-arent-doing-much-about-it/ [https://perma.cc/PJ98-5E44].

383. Complaint at 1–2, 11, New Mexico v. United States, No. 1:19-CV-00178 (D.N.M. Mar. 5, 2019), https://www.env.nm.gov/wp-content/uploads/2019/03/File-Stamped-Complaint.pdf [https://perma.cc/T6Q2-Y76H].

384. Transfer Order at 1–2, New Mexico v. United States, No. 1:19-CV-00178 (D.N.M. June 3, 2020), ECF No. 60.

385. Laura Paskus, *New Mexico Officials Say PFAS Court Decision Infringes on State's Rights*, NM PBS: GROUNDWATER WAR (Feb. 2, 2021), https://www.newmexicopbs.org/productions/groundwater-war/2021/02/02/new-mexico-officials-say-pfas-court-decision-infringes-on-states-rights/ [https://perma.cc/HA3D-QFFJ].

386. Kendra Chamberlain, *'Everyone Is Watching New Mexico': Update Shows No Progress on PFAS Clean Up*, NM POL. REP. (Nov. 7, 2019), https://nmpoliticalreport.com/2019/11/07/everyone-is-watching-new-mexico-update-shows-no-progress-on-pfas-clean-up/ [https://perma.cc/XU87-D7XP].

387. *See id.*

388. *Id.*

389. Announcement of Final Regulatory Determinations for Contaminants on the Fourth Drinking Water Contaminant Candidate List, 86 Fed. Reg. 12,272 (Mar. 3, 2021) (to be codified at 40 C.F.R. pt. 141).

future.[390] As the EPA begins formal rulemaking, it must consider how PFAS' unique properties impact their transport and persistence in our bodies and the environment.[391] Litigation has recognized that PFAS contamination goes beyond 3M and DuPont/Chemours;[392] regulation must do the same.

Vitally, regulators should not stop at PFOA and PFOS. However scientifically desirable,[393] regulating all several thousand PFAS as one class is unlikely at this time. But the goal must be for all major long- and short-chain PFAS to have clear regulatory schemes. Otherwise, PFAS manufacturers will continue to play "chemical whack-a-mole."[394]

PFAS should be regulated in both agricultural and drinking water. Admittedly, even at the dawn of a new era in PFAS regulation, agricultural water remains a challenge. First, there are the practical complexities of pre-treating agricultural water for PFAS.[395] Second, the exemptions woven through our existing water quality framework make it clear that the agricultural sector is not inclined to be an early adopter of PFAS regulation.[396] However unrealistic mandatory limits may be, rigorous monitoring is plausible and would be an improvement over the status quo. Now more than ever, municipal- and state-level monitoring of PFAS is crucial.

Federal regulators must recognize the Herculean task at hand and develop a regulatory framework that is agile and enduring. A watershed approach, particularly in the Colorado River Basin, allows for PFAS regulation that reflects hydrological reality. Further, it avoids the piecemeal nature of state-level regulation and the fragility of nationwide standards while still leveraging local communities and federal resources.

A. Yes to Two-Prong Regulation

Water regulation should supplement robust point-source regulation. Point-source regulation is necessary to avoid unnecessarily introducing PFAS to the water supply. This can be addressed by restricting use and disposal. For example, Arizona and Colorado's recent laws restricting the use of AFFFs

390. Press Release, EPA, EPA Delivers Results on PFAS Action Plan (Jan. 19, 2021), https://www.epa.gov/newsreleases/epa-delivers-results-pfas-action-plan [https://perma.cc/ZS6F-PRKP].

391. *See supra* Part I.

392. *See supra* Part III.

393. *See generally* Carol F. Kwiatkowski et al., *Scientific Basis for Managing PFAS as a Chemical Class*, 7 ENV'T SCI. & TECH. LETTERS 532 (2020).

394. Lustgarten et al., *supra* note 49.

395. *See, e.g.*, Declan Page et al., *Risks of Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS) for Sustainable Water Recycling via Aquifers*, WATER, Aug. 20, 2019, at 2.

396. *See supra* Section II.A.1.

minimize the chances for environmental contamination.[397] The most towering federal action to date came in the 2020 defense bill.[398] In addition to formalizing a DOD policy phasing out AFFFs,[399] Congress added a laundry list of PFAS to the EPA's Toxic Release Inventory.[400] In October 2021, partly in response to pressure from New Mexico's governor, the EPA initiated the process to propose designating PFOA, PFOS, PFBS, and GenX as hazardous waste.[401] Doing so will allow the EPA to regulate PFAS throughout its lifecycle—including storage and disposal. Still, point-source regulation is largely useless against the PFAS that linger in the environment after decades of widespread use.[402]

Agricultural and drinking water must also be regulated due to the PFAS' persistence once in the water supply.[403] Humans get their daily dose of PFAS through food and water.[404] While additional water treatment is costly, the harm PFAS cause makes it necessary. PFAS contamination is a classic negative externality problem: Little will happen without regulation (except lengthy and creative lawsuits).[405] An effective regulatory scheme would impose clear, mandatory standards and provide funding for implementation.

There is no silver bullet for resolving PFAS contamination in food and water. Point-source regulation of PFAS in agricultural water by the EPA would improve downstream water quality but would not necessarily address

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397. ARIZ. REV. STAT. ANN. § 36-1696 (2021); COLO. REV. STAT. § 24-33.5-1234 (2021).

398. Jeffrey Dintzer & Gregory Berlin, *Insight: Congress Confronts PFAS in National Defense Authorization Act-What You Need To Know*, BLOOMBERG L. (Mar. 20, 2020, 1:01 AM), https://news.bloomberglaw.com/environment-and-energy/insight-congress-confronts-pfas-in-national-defense-authorization-act-what-you-need-to-know [https://perma.cc/JDW4-C2A8]; National Defense Authorization Act for Fiscal Year 2020, Pub. L. No. 116-92, §§ 7301–62, 133 Stat. 1198, 2275–90 (2019).

399. David Vergun, *DOD Addressing PFAS Contamination, Official Says*, U.S. DEP'T OF DEF. (Mar. 11, 2020), https://www.defense.gov/Explore/News/Article/Article/2109373/dod-addressing-pfas-contamination-official-says/ [https://perma.cc/88VS-MGAM].

400. Dintzer & Berlin, *supra* note 398; *Chemicals Added to the Toxic Release Inventory Pursuant to Section 7321 of the National Defense Authorization Act*, EPA (Feb. 19, 2020), https://www.epa.gov/sites/production/files/2020-02/documents/tri_non-cbi_pfas_list_2_19_2020_final_clean.pdf [https://perma.cc/NYV3-XSA7].

401. Press Release, EPA, EPA Responds to New Mexico Governor and Acts To Address PFAS Under Hazardous Waste Law (Oct. 26, 2021), https://www.epa.gov/newsreleases/epa-responds-new-mexico-governor-and-acts-address-pfas-under-hazardous-waste-law [https://perma.cc/TLR4-JJGL].

402. *See supra* Section I.B.

403. *See supra* Section I.B.

404. AGENCY FOR TOXIC SUBSTANCES & DISEASE REGISTRY, *supra* note 36.

405. David Keiser et al., *The Social Cost of Water Pollution*, RES. MAG. (May 16, 2019), https://www.resourcesmag.org/archives/social-cost-water-pollution/ [https://perma.cc/S6F5-2H7X].

food contamination.[406] Further, the return flow exemption limits the reach of such a standard. However, rather than abandoning agricultural standards altogether, they must be viewed as part of the puzzle. Regulating both agricultural and drinking water, albeit differently, is a crucial step in breaking the cycle of PFAS contamination.

B. No to Status Quo

Traditional water quality regulatory schemes—both at the federal and state level—fail to address PFAS in water. State-level regulation is piecemeal and unpredictable, while nation-wide standards are likely to be insufficiently tailored to an area's needs, resulting in over- and under-regulation.

1. Federal Regulation: One-Size-Fits-All Fits None

Conventional federal regulation fails because it leaves PFAS to bright-line rules made by regulators driven by politics and efficiency rather than hydrological reality. PFAS contamination is in the crosshairs of both environmental issues and administrative law, making its federal regulation political and prone to variability across administration.

There are two notable examples of PFAS' recent politicization. In 2017, a nominee for the EPA's chemical safety office withdrew because North Carolina's "reliably pro-business conservative[ ]" senators refused to support him due to his ongoing role as a chemical-industry insider in underselling the risks associated with PFAS in water.[407] Soon after, Scott Pruitt, former Administrator of the EPA, prevented Health and Human Services from releasing a report regarding PFOA and PFOS.[408] The report reveals that the federal advisory limits are grossly inadequate and the chemicals are more dangerous than previously acknowledged, exposing industry players and the DOD to heightened liability.[409]

Yet, the EPA's announcement of its intent to regulate PFOA and PFOS in drinking water on the last day of the Trump administration[410] suggests that PFAS regulation has reached a turning point. Still, relying wholly on federal administration of water quality standards risks allowing PFAS to become

406. *See Our Current Understanding*, *supra* note 18.

407. Michael Biesecker, *GOP Senators from NC Come out Against Trump EPA Nominee*, AP (Nov. 15, 2017), https://apnews.com/article/07be552e19a34b268c225960150a6875 [https://perma.cc/3KX4-S87R].

408. Snider, *supra* note 135.

409. *Id.*

410. EPA, *supra* note 390.

another issue that swings in tandem with the pendulum of politics. Today's EPA is almost certainly going to impose more stringent standards than it would have under Trump[411]—and what of the next presidential administration?

Politics aside, a one-size-fits-all approach ignores both the varied means and concentrations of PFAS exposure across the country and the diversity of water sources and uses. One region may need to aggressively target a particular PFAS while another might target a particular means of exposure.

2. State Regulation: A Framework Only a Lawyer Could Love

The current state-by-state piecemeal approach fails to minimize indirect and direct human exposure to PFAS and yields cumbersome litigation. Upstream failures to address PFAS leave homeowners to install costly reverse osmosis systems[412]—or drink up. Further, the relative lack of knowledge surrounding PFAS may prevent even households who can shoulder the cost from doing so.[413] Individuals must suffer adverse effects before bringing cumbersome litigation against point-sources.

Without regulatory clarity, reliance on state common-law claims has yielded unpredictability that is bad for all parties.[414] Litigation is too little, too late, for those who face health effects. The absence of mandatory standards makes it easier for point source polluters to escape accountability. It may be difficult to prove causation and to satisfy knowledge requirements. For producers and users, litigation is a wild card. It is problematic to manage a diffuse and highly transportable pollutant on a state-by-state basis.

C. A Watershed Approach

Watershed regulatory plans are well-suited to reduce PFAS contamination and mitigate the risk of exposure through both agricultural and drinking water. If state-by-state regulation by fifty states and numerous tribes *is too little*, and nationwide regulation is *too much*, regional regulation is *just right*. The EPA itself identifies watershed approaches as one of its Four Pillars for promoting sustainable water infrastructure, encouraging state and local

411. *See* Oliver Milman & Alvin Chang, *How Biden Is Reversing Trump's Assault on the Environment*, GUARDIAN (Feb. 2, 2021, 11:00 AM), https://www.theguardian.com/us-news/2021/feb/02/biden-trump-environment-climate-crisis [https://perma.cc/PH94-LPN4].

412. *Reducing PFAS in Drinking Water with Treatment Technologies*, *supra* note 108.

413. *See, e.g.*, DANISH ENV'T PROT. AGENCY, *supra* note 74, at 9.

414. *Supra* Part III.

governments "to look beyond their traditional geographic boundaries" and "create . . . partnerships based on watershed boundaries."[415]

But where should the lines be drawn? A watershed consists of all the water that flows together to a certain point.[416] For the Colorado River Basin, that point is the Gulf of California.[417] Today, massive pipelines and canals sometimes carry water where it isn't. Thus, for the sake of this analysis, the Colorado River Basin includes the Basin and the communities reached through artificial conveyance.

1. Not Too Big, Not Too Small

Watershed plans are more efficient than either a national rule or state-by-state approach. An area with more PFAS producers (e.g., the Great Lakes region) can aggressively target point-sources, while an area with more dilute use (e.g., the Colorado River Basin) might target agricultural and drinking water. Additionally, a watershed regulatory plan would provide more certainty than case-by-case litigation.

A watershed plan also addresses the collective action problems inherent to water quality regulation. Such a plan avoids free-rider problems and equalizes stakeholders by diffusing costs rather than concentrating them downstream. Upstream agricultural water users and drinking water suppliers may bear more costs than they would in a state-by-state scheme, but that amount could be offset by contributions from downstream benefactors. Conveniently, much of the Colorado River Basin's water-intensive agriculture happens downstream, reducing the severity of this issue. An effective regional plan would both establish clear and reliable regulatory standards and establish a fund for implementation and monitoring.

A basin-wide program for PFAS would not be conflict-free, as the divergent regulatory approaches of Arizona and California make clear. Still, a regional plan may be more attractive to states like Arizona than a nationwide standard, especially if the program successfully diffuses costs.

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415. EPA, TOOLS FOR FINANCING WATER INFRASTRUCTURE 2 (2007), https://www.epa.gov/sites/production/files/2016-01/documents/waterinfra2007.pdf [https://perma.cc/7DC9-3YGZ].

416. *What Is a Watershed?*, NAT'L OCEAN SERV., https://oceanservice.noaa.gov/facts/watershed.html [https://perma.cc/RT9Q-4VRY].

417. *Colorado River*, AM. RIVERS, https://www.americanrivers.org/river/colorado-river/ [https://perma.cc/Y2D5-ARLZ].

2. Just Right: Achieving a Goldilocks Zone

The Colorado River Basin could model a PFAS Compact on its Salinity Control Program.[418] The Colorado River Basin Salinity Control (CRBSC) Program arose from treaty obligations to Mexico and rising mitigation costs.[419] First enacted in 1974, it serves to mitigate the naturally occurring and human-caused salinity of Colorado River water.[420] Today, the Program provides financial and technical assistance to farmers and ranchers that pursue more water-efficient technologies and practices.[421] The USDA, Bureau of Reclamation, and Bureau of Land Management administer the Program.[422] Each of the seven Basin states may send up to three governor-appointed representatives to the CRBSC Advisory Council, which coordinates efforts between the states and federal agencies.[423]

A PFAS Control Program would be similarly structured. It could be created in two ways: (1) Congressional enactment, like with the CRBSC Program, or (2) Interstate compact, entered by the Basin states and approved by Congress.[424] Funding could come from the USDA's existing Environmental Quality Improvement Program (EQIP),[425] settlement awards

418. Nat. Res. Conservation Serv., *supra* note 240.

419. *Id.*

420. Colorado River Basin Salinity Control Act, Pub. L. No. 93-320, 88 Stat. 266 (1974) (codified as enacted at 43 U.S.C. §§ 1571–99); S. REP. NO. 93-906, at 3356 (1974).

421. § 1571.

422. Nat. Res. Conservation Serv., *supra* note 240 (discussing USDA role); *Colorado River Basin Salinity Control Program*, BUREAU OF RECLAMATION, https://www.usbr.gov/uc/progact/salinity/ [https://perma.cc/6Q5Y-2FRR] (discussing Bureau of Reclamation role); ROBERT BOYD & COLE GREEN, BUREAU OF LAND MGMT., A FRAMEWORK FOR IMPROVING THE EFFECTIVENESS OF THE COLORADO RIVER BASIN SALINITY CONTROL PROGRAM, 2018–2023, at 1 (2018), https://www.blm.gov/sites/blm.gov/files/documents/files/Library_FrameworkImprovingEffectivenessCOBasinSalinityControlProgram_2018-2023.pdf [https://perma.cc/CYA2-94ZP] (discussing Bureau of Land Management role).

423. § 1594. There is also a CRBSC Forum, a non-governmental organization formed in 1973 that has coexisted with the Advisory Council—with nearly identical membership—since 1974. BOYD & GREEN, *supra* note 422, at 5.

424. *See, e.g.*, *Interstate Compacts*, U.S. FISH & WILDLIFE SERV., https://www.fws.gov/laws/lawsdigest/compact.html [https://perma.cc/8MFZ-ZWSJ] (detailing assorted interstate compacts involving water).

425. Nat. Res. Conservation Serv., *Environmental Quality Incentives Program*, USDA, https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/ [https://perma.cc/NL7B-F4WH].

from state-driven PFAS litigation,[426] and the DOD's Environmental Restoration Program.[427]

The EPA would set basin-specific water quality standards for both agricultural and drinking water. The USDA and its local service centers would coordinate with farmers and ranchers, first to comply with monitoring requirements, and eventually to meet agricultural water standards. Member states would implement and monitor PFAS drinking water standards, bolstered by federal funding and research assistance. Farmers, ranchers, and drinking water suppliers would receive financial support for necessary improvements through cost-share programs, grants, court settlements, and community-based, private-public partnerships.[428]

A regional regulatory scheme is necessary to protect Western interests in clean water. A watershed plan allows for a tailored response to PFAS contamination. PFOA and PFOS are first priorities, but regulation of short-chain PFAS should follow shortly. A successful scheme would set clear water quality standards and address point sources. Further, the Colorado River Basin cannot ignore the importance of agricultural and drinking water and must set concentration standards for both.

V. CONCLUSION

If states are willing to cooperate, a watershed can be a "Goldilocks" zone for PFAS regulation—local enough to be responsive to stakeholders while large enough to overcome collective action problems. The Colorado River Basin would be an ideal region for trying such a scheme due to its vast agricultural lands and known drinking water contamination.

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426. *See State Attorneys General Environmental Actions*, SABIN CTR. FOR CLIMATE CHANGE L., https://climate.law.columbia.edu/content/state-attorneys-general-environmental-actions [https://perma.cc/JD2Q-WQ25] (listing several environmental actions brought by attorneys general).

427. David Vergun, *DOD Officials Testify on Defense Environmental Restoration Program*, U.S. DEP'T OF DEF. (June 3, 2021), https://www.defense.gov/News/News-Stories/Article/Article/2634330/dod-officials-testify-on-defense-environmental-restoration-program/ [https://perma.cc/9ESC-EZAP] (citing PFAS mitigation efforts "on and off base").

428. *See, e.g.*, JILL E. KRUEGER, FARMERS' LEGAL ACTION GRP., INC., IS YOUR FARM "EQIPED" FOR CONSERVATION? 6–7 (2007), http://www.flaginc.org/wp-content/uploads/2013/03/FGtoEQIP.pdf [https://perma.cc/CW83-3H78] (detailing cost-sharing up to 75% through EQIP); BUREAU OF RECLAMATION, U.S. DEP'T OF THE INTERIOR, BASINWIDE & BASIN STATES SALINITY CONTROL PROGRAMS FUNDING OPPORTUNITY NO. BOR-UC-20-F001, (July 15, 2019) https://www.grants.gov/web/grants/view-opportunity.html?oppId=316619 [https://perma.cc/3H34-MMAM] (announcing grant application for projects reducing salinity); *Financing Green Infrastructure – Is a Community-Based Public-Private Partnerships (CBP3) Right for You?*, EPA, https://www.epa.gov/G3/financing-green-infrastructure-community-based-public-private-partnerships-cbp3-right-you [https://perma.cc/TYR6-83E3].

Almost seventy-five years after entering the market, and sixty-some years after DuPont and 3M recognized their toxicity,[429] PFAS are ripe for regulation. The EPA's drinking water standards for PFOS and PFOS will be foundational for all subsequent PFAS regulation and must be tailored to the PFAS problem. A watershed regulatory scheme is just that: adaptive, comprehensive, and—hopefully—as resilient as a carbon-fluorine bond. Successful PFAS regulation must be enduring: Confronting "forever chemicals" takes time.

429. Sharon Lerner, *3M Knew About the Dangers of PFOA and PFOS Decades Ago, Internal Documents Show*, INTERCEPT (July 31, 2018, 9:23 AM), https://theintercept.com/2018/07/31/3m-pfas-minnesota-pfoa-pfos/ [https://perma.cc/B547-Z58Y].