



December 5, 2018

The Honorable  
Rick Snyder  
Office of the Governor  
P.O. Box 30013  
Lansing, Michigan 48909

Gretchen Whitmer  
Governor-Elect of Michigan  
P.O. Box 15282  
Lansing, Michigan 15282

Mr. Eric Oswald, P.E., Chief  
Drinking Water and Municipal Assistance Division  
Michigan Department of Environmental Quality  
525 West Allegan Street  
P.O. Box 30473  
Lansing, Michigan 48909

CC: Michigan PFAS Action Response Team  
Scientific Advisory Committee  
Local Public Health Advisory Committee

**Re: Recommendations Regarding the Regulation of Perfluorooctanoic Acid (PFOA), Perfluorooctanesulfonic Acid (PFOS), Perfluorononanoic Acid (PFNA), Perfluorohexane Sulfonic Acid (PFHxS), GenX, and Related Per- and Polyfluoroalkyl (PFAS) Chemicals in Drinking Water**

Dear Governor Snyder, Governor-Elect Whitmer and Mr. Oswald,

We write on behalf of the Natural Resources Defense Council (NRDC) to urge the Michigan Department of Environmental Quality (DEQ) to exercise its authority under the

Michigan Safe Drinking Water Act<sup>1</sup> to regulate perfluorooctanoic acid (PFOA), perfluorooctanesulfonic acid (PFOS), perfluorononanoic acid (PFNA), perfluorohexane sulfonic acid (PFHxS), GenX<sup>2</sup>, and to issue a treatment technique drinking water standard for total per- and polyfluoroalkyl (PFAS) chemicals in drinking water.

PFOA, PFOS, PFNA, PFHxS, and GenX belong to a class of similarly-structured PFAS chemicals, which are manmade fluorinated compounds, prevalent in consumer products and industrial settings, and increasingly detected in drinking water. The toxicity of these contaminants is well-established.

The state of Michigan has in recent years become the epicenter of a nationwide PFAS crisis. New sites bearing unsafe levels of contamination are unveiled with alarming regularity. From Ann Arbor, to Plainfield Township, to Genesee County, residents' drinking water is at risk. While Michigan has taken important steps towards evaluating the prevalence of certain PFAS chemicals in drinking water and their associated health risks, the state has so far failed to set a health-protective drinking water standard for PFAS.

In the absence of adequate federal safeguards, Michigan must act to protect drinking water, reduce risks to the public, and remediate contaminated drinking water sources. The present crisis necessitates swift adoption of stringent Maximum Contaminant Levels<sup>3</sup> and Maximum Contaminant Level Goals<sup>4</sup> for PFOA, PFOS, PFNA, PFHxS, and GenX due to the clear and mounting evidence demonstrating the link between low dose-exposures to these chemicals and serious human health risks, including cancer and adverse immunological, developmental and neurological affects. Further, while there is limited toxicity data for PFAS outside the more-studied contaminants listed above, a growing body of scientific research indicates that the class collectively poses similar threats to human

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<sup>1</sup> MICH. COMP. LAWS § 325.1001 et seq.

<sup>2</sup> As explained by the U.S. Environmental Protection Agency, “GenX is a trade name for a processing aid technology developed by DuPont (now Chemours). In 2008, EPA received new chemical notices under the Toxic Substance Control Act from DuPont (which is now Chemours) for two chemical substances that are part of the GenX process (Hexafluoropropylene oxide (HFPO) dimer acid and the ammonium salt of HFPO dimer acid).” See EPA, GenX Chemicals Studies, <https://www.epa.gov/pfas/genx-chemicals-studies> (last visited Dec. 4, 2018).

<sup>3</sup> Maximum Contaminant Level (“MCL”) means the maximum permissible level of a contaminant in water which is delivered to any user of a public water system. See 42 U.S.C. § 300f (3); MICH. COMP. LAWS § 325.1006.

<sup>4</sup> Maximum Contaminant Level Goal (“MCLG”) means the maximum level of a contaminant in drinking water at which no known or anticipated adverse effect on the health of persons would occur, allowing an adequate margin of safety. See 42 U.S.C. § 300g-1; MICH. ADMIN CODE R 325.10413.

health and the environment. Therefore, the state must also set a Maximum Contaminant Level Goal and a Treatment Technique<sup>5</sup> for the full suite of PFAS chemicals.

Over the past two years, NRDC has conducted a detailed review of PFAS contamination in Michigan and elsewhere. As part of this effort, NRDC staff scientist Anna Reade, Ph.D.,<sup>6</sup> our retained expert consultant, Judith Schreiber, Ph.D.,<sup>7</sup> have made recommendations regarding the appropriate Maximum Contaminant Levels and Maximum Contaminant Level Goals, and other actions that the state may take to safeguard public health.

As set forth in more detail below, NRDC writes now to urge DEQ, under clear authority established by the Michigan Safe Drinking Water Act,<sup>8</sup> to issue a proposal for rulemaking adopting the following measures:

1. Michigan should within 180 days establish an enforceable Maximum Contaminant Level for PFOA, PFOS, PFNA, and PFHxS at a combined concentration of 2 parts per trillion (ppt), a Maximum Contaminant Level for GenX at a concentration of 5 ppt, and a Maximum Contaminant Level Goal for PFOA, PFOS, PFNA, PFHxS, and GenX of zero. Michigan should within two years set a Maximum Contaminant Level Goal of zero for the class of PFAS chemicals and a Treatment Technique for the PFAS class based on the best available detection and treatment technologies. Simultaneously, DEQ should decrease the state's groundwater cleanup standard for combined concentrations of PFOA and PFOS from 70 ppt to 2 ppt and include combined levels of PFNA and PFHxS into the standard. An additional groundwater cleanup standard of 5 ppt should also be set for GenX.
2. Michigan should expedite its current statewide survey of drinking water sources and conduct additional rounds of testing to validate prior results. DEQ should offer additional testing of drinking water from private wells in or proximate to sites known or suspected to be at risk of PFAS contamination. In addition to PFOA and PFOS, DEQ should test all public water systems for the full suite of PFAS.

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<sup>5</sup> Treatment Technique ("TT") means an enforceable procedure or level of technological performance which public water systems must follow to ensure control of a contaminant. *See* MICH. ADMIN CODE R 325.10109(g).

<sup>6</sup>Anna Reade, Ph.D., is a scientist with the Natural Resources Defense Council. She previously worked in the California State Senate with the California Council on Science and Technology.

<sup>7</sup>Judith Schreiber, Ph.D., is a former Chief Scientist at the Environmental Protection Bureau of the New York State Office of the Attorney General and former Section Chief of Environmental Research at the New York State Department of Health.

<sup>8</sup> *See* MICH. COMP. LAWS § 325.1005(1)(b).

3. Michigan should conduct a comprehensive health assessment of residents in Michigan communities found to have elevated PFAS concentrations in drinking water.
4. Michigan should mandate provision of public education materials to residents served by contaminated water and to physicians. Such materials should include information regarding infants' and pregnant women's special vulnerability to PFAS exposure. In these materials, breastfeeding women exposed to elevated PFAS in drinking water should be advised of the benefits and risks of breastmilk, whether use of bottled water or a filter is recommended, and be provided with information to discuss with their family doctor and pediatrician.

A full report outlining our recommendations and the basis for these recommendations will be released in early 2019. This letter seeks to preview the report's findings and reasoning in anticipation of the issuance of recommendations regarding policy actions on PFAS by the Michigan PFAS Action Response Team (MPART).

Because of the high prevalence of PFAS chemicals in drinking water sources across Michigan and the robust scientific evidence that PFAS present unacceptable harm to human health at very low levels, Michigan must take the aforementioned urgent actions to limit residents' exposure to these dangerous chemicals.

## **I. Background**

### **A. Natural Resources Defense Council**

The Natural Resources Defense Council (NRDC) is an international nonprofit environmental organization with more than 3 million members and online activists, including more than 10,000 members in Michigan. Since 1970, NRDC has worked to protect Americans from toxic contaminants in their drinking water. NRDC led efforts to strengthen the Safe Drinking Water Act in the 1986 and 1996 Amendments. NRDC has also spearheaded national campaigns for more protective EPA drinking water rules for microbial contaminants and toxic metals and chemicals. In Michigan, NRDC successfully litigated to enforce the Safe Drinking Water Act in Flint, Michigan, in the wake of the city's

devastating lead crisis. NRDC advocated for a strengthened Lead and Copper Rule and other key drinking water standards in the state.<sup>9</sup>

## B. Per- and Polyfluoroalkyl Substances (PFAS)

Per- and polyfluoroalkyl substances (PFAS) are a group of man-made chemicals that include perfluorooctanoic acid (PFOA), perfluorooctanesulfonic acid (PFOS), perfluorononanoic acid (PFNA), perfluorohexane sulfonic acid (PFHxS), and GenX. Since the 1940s, these chemicals have been widely used in industrial settings and consumer products, including nonstick cookware (e.g., Teflon), stain-resistant repellents used on carpets and fabric (e.g., Scotchgard and Stainmaster), paper and cardboard food packaging (e.g., fast food wrappers),<sup>10</sup> firefighting foam, textiles (e.g., Gore-Tex), toothpaste, shampoos, cosmetics, polishes and waxes, pesticides and herbicides, windshield wipers, and many products for the aerospace, automotive, construction, and electronic industries.<sup>11</sup>

While PFAS do not occur naturally in the environment, due to widespread use, PFAS are now ubiquitous across the planet – present in rivers, soil, air, house dust, food and drinking water from surface and groundwater sources. PFAS are extremely persistent in the environment, meaning they are resistant to environmental degradation.<sup>12</sup> They can thus

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<sup>9</sup> See David Eggert, Michigan Now Has Nation's Toughest Rules for Lead in Drinking Water, Detroit Free Press (June 14, 2018), <https://www.freep.com/story/news/local/michigan/flint-water-crisis/2018/06/14/michigan-lead-flint-water-rules/702781002/>.

<sup>10</sup> See Amy Martyn, *Anti-grease Chemicals Used in Fast Food Wrappers Can Accumulate in Organs, Study Finds*, CONSUMER AFFAIRS (Mar. 30, 2017), <https://www.consumeraffairs.com/news/anti-grease-chemicals-used-in-fast-food-wrappers-can-accumulate-inorgans-study-finds-033017.html>.

<sup>11</sup> See INTERSTATE TECH. & REGULATORY COUNCIL, History and Use of Per- and Polyfluoroalkyl Substances (PFAS) (Nov. 2017), [https://pfas-1.itrcweb.org/wp-content/uploads/2017/11/pfas\\_fact\\_sheet\\_history\\_and\\_use\\_\\_11\\_13\\_17.pdf](https://pfas-1.itrcweb.org/wp-content/uploads/2017/11/pfas_fact_sheet_history_and_use__11_13_17.pdf); U.S. ENVTL. PROT. AGENCY, Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA), EPA DOC. NO. 822-R-16-005, at 24 (May 2016), [https://www.epa.gov/sites/production/files/2016-05/documents/pfoa\\_health\\_advisory\\_final\\_508.pdf](https://www.epa.gov/sites/production/files/2016-05/documents/pfoa_health_advisory_final_508.pdf); U.S. ENVTL. PROT. AGENCY, Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS), EPA DOC. NO. 822-R-16-004, at 24-25 (May 2016), [https://www.epa.gov/sites/production/files/2016-05/documents/pfos\\_health\\_advisory\\_final\\_508.pdf](https://www.epa.gov/sites/production/files/2016-05/documents/pfos_health_advisory_final_508.pdf).

<sup>12</sup> U.S. ENVTL. PROT. AGENCY, Technical Factsheet for Perfluorooctane Sulfonate (PFOS) and Perfluorooctanoic Acid (PFOA) (Nov. 2017), [https://www.epa.gov/sites/production/files/2017-12/documents/ffrrofactsheet\\_contaminants\\_pfos\\_pfoa\\_11-20-17\\_508\\_0.pdf](https://www.epa.gov/sites/production/files/2017-12/documents/ffrrofactsheet_contaminants_pfos_pfoa_11-20-17_508_0.pdf).

move through the soil and into groundwater and remain there for many years.<sup>13</sup> They also are found in over 98 percent of Americans' bodies.<sup>14</sup>

A substantial body of scientific evidence demonstrates the link between low dose-exposures of PFOA, PFOS, PFNA, PFHxS, and GenX and serious human health risks, including cancer and adverse immunological, developmental, and neurological effects. Adverse health effects identified in scientific studies in humans include testicular and kidney cancer (PFOA), liver and thyroid cancer (PFOS), thyroid disease and pregnancy-induced hypertension pregnancy-induced hypertension/pre-eclampsia (PFOA and PFOS); liver damage (PFOA, PFOS and PFHxS); increases in serum lipids, particularly total cholesterol and low-density lipoprotein (PFOA, PFOS, PFNA); increased risk of thyroid disease (PFOA and PFOS); immunological effects such as decreased antibody response to vaccines (PFOA, PFOS, PFHxS); increased risk of asthma diagnosis (PFOA); increased risk of decreased fertility (PFOA and PFOS); and small decreases in birth weight (PFOA and PFOS).<sup>15</sup> Similar adverse health effects have been identified in in animal studies and include liver and/or kidney damage (PFOA, PFOS, PFHxS, PFNA, GenX, and PFBS); thyroid effects and endocrine disruption (PFOA, PFOS, PFNA, PFHxS, and PFBS); developmental toxicity such as delayed development (PFOA, PFOS, PFNA, PFBS, and GenX), decreases in litter size and survival (PFOA, PFOS, and PFNA), effect on neurodevelopment (PFOS and PFHxS) and skeletal alterations (PFOA); reproductive toxicity such as delays or defects in reproductive organ development (PFOA, PFNA, and PFBS); immunotoxicity (PFOA, PFOS, and GenX); effects on blood (PFHxS, GenX, and PFBS); and cancer (PFOA, PFOS, GenX).<sup>15,16,17</sup>

PFAS share similar chemical properties and are co-contaminants in the environment and in people's bodies. While there is limited toxicity data for PFAS outside the more-

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<sup>13</sup> See U.S. ENVTL. PROT. AGENCY, Technical Factsheet for Perfluorooctane Sulfonate (PFOS) and Perfluorooctanoic Acid (PFOA) (Nov. 2017), [https://www.epa.gov/sites/production/files/2017-12/documents/ffrofactsheet\\_contaminants\\_pfos\\_pfoa\\_11-20-17\\_508\\_0.pdf](https://www.epa.gov/sites/production/files/2017-12/documents/ffrofactsheet_contaminants_pfos_pfoa_11-20-17_508_0.pdf).

<sup>14</sup> Antonia M. Calafat *et al.*, *Polyfluoroalkyl Chemicals in the U.S. Population: Data from the National Health and Nutrition Examination Survey (NHANES) 2003–2004 and Comparisons with NHANES 1999–2000*, 115 ENVTL. HEALTH PERSP. 11, 1596-1602 (2007); see also U.S. CTRS. FOR DISEASE CONTROL & PREVENTION, National Biomonitoring Program: Biomonitoring Summary, Perfluorochemicals, [https://www.cdc.gov/biomonitoring/PFAS\\_BiomonitoringSummary.html](https://www.cdc.gov/biomonitoring/PFAS_BiomonitoringSummary.html) (last visited Sept. 3, 2018).

<sup>15</sup> U.S. DEP'T HEALTH & HUM. SERVS., AGENCY FOR TOXIC SUBSTANCE & DISEASE REGISTRY, Toxicological Profile for Perfluoroalkyls, Draft for Public Comment (June 2018).

<sup>16</sup> U.S. ENVTL. PROT. AGENCY, Toxicity Assessment: Human Health Toxicity Values for Hexafluoropropylene Oxide (HFPO) Dimer Acid and Its Ammonium Salt (CASRN 13252-13-6 and CASRN 62037-80-3) (Nov. 2018)

<sup>17</sup> U.S. ENVTL. PROT. AGENCY, Toxicity Assessment: Human Health Toxicity Values for Perfluorobutane Sulfonic Acid (CASRN 375-73-5) and Related Compound Potassium Perfluorobutane Sulfonate (CASRN 29420-49-3) (Nov. 2018).

studied contaminants listed above, a growing body of scientific research indicates that the class collectively poses similar threats to human health and the environment.

## II. PFAS Contamination Has Been Discovered Across the United States and is Highly Prevalent in Michigan.

Elevated PFAS levels have been detected in drinking water supplies across the country, in at least 33 states, 3 territories, and one indigenous community, contaminating the water supplies of millions of people.<sup>18</sup> Exceedances of EPA's health advisory limit have been detected in Alaska, Arizona, California, Colorado, Florida, Illinois, Indiana, Kentucky, Massachusetts, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Texas, and Vermont, among other states.<sup>19</sup> Elevated levels of PFOA and PFOS in drinking

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<sup>18</sup> See Xindi C. Hu *et al.*, *Detection of Poly- and Perfluoroalkyl Substances (PFASs) in U.S. Drinking Water Linked to Industrial Sites, Military Fire Training Areas, and Wastewater Treatment Plants*, 3 ENVTL. SCI. & TECH. LETTERS 344 - 346, fig.1 (2016) [hereinafter Hu *et al.*, *Detection of PFAS*] (using data from EPA's third Unregulated Contaminant Monitoring Rule in order to create maps to display where PFOS and PFOA have been found in water supplies).

<sup>19</sup>*Id.*; see also Tim Ellis, 'Dire Health Effects': Local Group Seeks Strict Regulation of Firefighting-foam Chemicals, KUAC (Nov. 28, 2017), <http://fm.kuac.org/post/dire-health-effects-local-group-seeks-strict-regulation-firefighting-foam-chemicals> (Alaska); Bruce Finley, *Air Force Sends First \$400,000 Filter to Fountain to Scrub PFC Contamination from Ground Water*, DENVER POST, <http://www.denverpost.com/2017/06/29/air-force-filter-fountain-colorado-contaminated-water/> (last updated Jul. 3, 2017) (Colorado); Jess Mancini, *No Surprises in C8 Report: Study Finds Higher Concentrations*, PARKERSBURG NEWS & SENTINEL (May 26, 2017), <http://www.newsandsentinel.com/news/local-news/2017/05/researcher-no-surprises-in-c8-report> (Indiana); Garret Ellison, *PFAS Found In Drinking Water Wells In Unexpected Places*, MLIVE (Nov. 8, 2017), [http://www.mlive.com/news/grand-rapids/index.ssf/2017/11/pfas\\_private\\_well\\_test\\_results.html](http://www.mlive.com/news/grand-rapids/index.ssf/2017/11/pfas_private_well_test_results.html) (Michigan); *Officials: Elevated Levels of PFOA Measured near Landfill*, WASH. TIMES (Jun. 4, 2016), <http://www.washingtontimes.com/news/2016/jun/4/officials-elevated-levels-of-pfoa-measured-near-la/> (New Hampshire); Jeff Hirsh, *Drinking Water Safety Concerns: New Historical Evidence of "PFOA" in Ohio River*, LOCAL12.COM (May 25, 2017), <http://local12.com/news/local/drinking-water-safety-concerns-new-historical-evidence-of-pfoa-in-ohio-river> (Ohio); TEXAS MILITARY DEPARTMENT, DRINKING WATER SAMPLING RESULTS NOTIFICATION (2017), available at <https://tmd.texas.gov/Data/Sites/1/media/press-releases/2017/may/18may/tmd-pfos-pfoa-results-notification-fact-sheet-17-may.pdf> (Texas); Brad Evans & Renee Wunderlich, 'Stop Drinking the Water': Pownal Municipal Samples Test Positive for PFOA, NBC5 (Mar. 24, 2016, 6:25 PM), <http://www.mynbc5.com/article/stop-drinking-the-water-pownal-municipal-samples-test-positive-for-pfoa/3326716> (Vermont).

water are strongly associated with proximity to major industrial sites, civilian airports, and military fire training areas.<sup>20</sup>

Because of the burgeoning number of sites revealing PFAS contamination in the state, Michigan has been dubbed the “current hotspot of the PFAS crisis.”<sup>21</sup> Elevated levels of PFOA and PFOS have been discovered in communities spanning the breadth of the state: in the drinking water in Ann Arbor (serving a population of 114,000) and Plainfield Township (serving a population of 40,891)<sup>22</sup> and in individual water systems in Allegan County, Berrien County, Charlevoix County, Genesee County, Ionia County, Kalamazoo County and Grand Rapids, among other areas.<sup>23</sup> These elevated concentrations are likely to occur in many other communities across the state. Indeed, recent reports suggest that DEQ has stated that PFAS contamination may occur at more than 11,300 sites statewide.<sup>24</sup>

### **III. The Michigan Department of Environmental Quality Enjoys the Authority and Obligation Under Michigan Law to Promulgate the Recommended Regulations**

The authority to issue NRDC’s recommended regulations sits squarely within DEQ’s purview. The Michigan Safe Drinking Water Act confers wide authority upon DEQ to regulate contaminants in drinking water, including setting a Maximum Contaminant Level and Maximum Contaminant Level Goal, where such standards are “necessary to protect human health.”<sup>25</sup> Under Michigan law, DEQ enjoys broad powers to regulate contaminants in drinking water pursuant to the Act.<sup>26</sup> The Act establishes DEQ as the agency with primary responsibility for implementing and enforcing the federal Safe Drinking Water Act in Michigan, and for setting health-protective drinking water standards. Under the Act, DEQ is authorized to promulgate and enforce rules setting “drinking water standards and associated monitoring requirements, the attainment and maintenance of

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<sup>20</sup> Hu *et al.*, *Detection of PFAS*, *supra* note 10, at 345.

<sup>21</sup> Bill Walker, *Update: Mapping the Expanding PFAS Crisis*, ENVTL. WORKING GROUP (July 30, 2018), <https://www.ewg.org/research/update-mapping-expanding-pfas-crisis#.W3oipOhKjIU>.

<sup>22</sup> Env’tl. Working Group, *Toxic Fluorinated Chemicals in Tap Water and at Industrial or Military Sites* (accessed Aug. 19, 2018), available at [https://www.ewg.org/interactive-maps/2017\\_pfa/#.W3ojwehKjIU](https://www.ewg.org/interactive-maps/2017_pfa/#.W3ojwehKjIU).

<sup>23</sup> Mich. Dep’t Env’tl. Quality, *Statewide Testing Initiative for Public Water Supplies* (2018), [https://www.michigan.gov/pfasresponse/0,9038,7-365-86510\\_87918-474941--,00.html](https://www.michigan.gov/pfasresponse/0,9038,7-365-86510_87918-474941--,00.html).

<sup>24</sup> Keith Matheny, *DEQ: Harmful PFAS Might Contaminate More than 11,000 Sites Statewide* (July 30, 2018), <https://www.freep.com/story/news/local/michigan/2018/07/30/deq-pfas-chemical-contamination-pollution-michigan/851152002/>.

<sup>25</sup> MICH. COMP. LAWS § 325.1005(1)(b).

<sup>26</sup> MICH. COMP. LAWS § 325.1001 *et seq.*

which are necessary to protect the public health.”<sup>27</sup> “State drinking water standards,” are further defined under the Act as “quality standards setting limits for contaminant levels or establishing treatment techniques to meet standards necessary to protect the public health.”<sup>28</sup> DEQ is charged with issuing regulations regarding public education and notification materials once a water system has exceeded a Maximum Contaminant Level. Michigan law provides that the Michigan Administrative Procedures Act applies to the promulgation of state drinking water standards.<sup>29</sup>

In addition to the Michigan drinking water law’s explicit grant of authority to DEQ to issue standards for tap water safety, the Michigan Environmental Protection Act (MEPA), imposes upon the state a broad mandate, enforceable by citizens, “for the protection of the air, water, and other natural resources and the public trust in these resources from pollution, impairment, or destruction.”<sup>30</sup> MEPA has long protected citizens’ drinking water from impairment or destruction, and its text, case law, and legislative history support a broader understanding—that MEPA protects citizens’ access to clean drinking water against impairment or destruction. Under MEPA the state is under an affirmative obligation to protect such access from impairment or destruction. Additionally, Art. 4, § 52 of the Michigan Constitution declares “[t]he conservation and development of the natural resources of the state . . . to be of paramount public concern in the interest of the health, safety and general welfare of the people.”<sup>31</sup> This further reinforces the state’s and DEQ’s obligation to protect the public’s drinking water from PFAS contamination.

Moreover, under federal law, states are free to adopt and enforce laws respecting drinking water or public water systems that are stricter than federal standards. The federal Safe Drinking Water Act expressly provides that state regulators may set contaminant standards more rigorous and “not less stringent” than what is required under EPA’s national primary drinking water regulations.<sup>32</sup>

NRDC appreciates Governor Snyder’s establishment of the Michigan PFAS Action Response Team and its two advisory committees – the Scientific Advisory Committee and the Local Public Health Advisory Committee – to coordinate interagency action, to review available science, and to make recommendations to the state. Michigan has also commenced legal action against Wolverine World Wide, a manufacturer of PFOA and

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<sup>27</sup> MICH. COMP. LAWS § 325.1005(1)(b).

<sup>28</sup> MICH. COMP. LAWS § 325.1002(q).

<sup>29</sup> MICH. COMP. LAWS § 325.1005(1)

<sup>30</sup> MICH. COMP. LAWS ANN. § 691.1201(1) (Supp. 1973).

<sup>31</sup> MICH. CONST., Art IV, § 52.

<sup>32</sup> See 42 U.S.C. § 300j-2.

PFOS.<sup>33</sup> However, more must be done to safeguard public health and safety in light of the prevalence and toxicity of these dangerous chemicals.

#### **IV. There is Ample Evidence of the Adverse Health Effects of PFOA, PFOS, PFNA, PFHxS, GenX and the PFAS Class**

In early 2019, NRDC will release a scientific report on PFAS co-authored by NRDC Staff Scientist Anna Reade, Ph.D., and Judith Schreiber, Ph.D., former Chief Scientist at the Environmental Protection Bureau of the New York State Office of the Attorney General and former Section Chief of Environmental Research at the New York State Department of Health. This forthcoming report will provide the scientific basis for NRDC's recommendations regarding proposed regulatory actions in Michigan. NRDC seeks to provide Michigan with the report's findings in advance of the issuance of recommendations regarding policy actions on PFAS by the Michigan PFAS Action Response Team (MPART).

A substantial body of scientific literature on PFOA, PFOS, PFNA, PFHxS, and GenX demonstrates these chemicals' association with adverse health effects; some of these effects, such as developmental harm and immunotoxicity, occur at extremely low levels of exposure. Numerous toxicological studies in humans and animals have found associations between exposure to PFOA and PFOS and increased cancer risk. Several authoritative bodies have made findings on the chemicals' carcinogenic potential. PFOA, for example, has been identified as a probable human carcinogen by the C8 Science Panel.<sup>34</sup> PFOA has also been classified as a possible human carcinogen by the World Health Organization's International Agency for Research on Cancer.<sup>35</sup> Further, the EPA Office of Water and the EPA Science Advisory Board has determined that PFOA and PFOS demonstrate suggestive and likely evidence of carcinogenic potential, respectively.<sup>36</sup> While PFNA, PFHxS, and

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<sup>33</sup> Garret Ellison, *Michigan Sues Wolverine as EPA Deepens PFAS Investigation*, GRAND RAPIDS NEWS (Jan. 10, 2018), [https://www.mlive.com/news/grand-rapids/index.ssf/2018/01/wolverine\\_deq\\_pfas\\_lawsuit.html](https://www.mlive.com/news/grand-rapids/index.ssf/2018/01/wolverine_deq_pfas_lawsuit.html).

<sup>34</sup> See C8 Science Panel, The Science Panel Website (last updated Jan. 4, 2017), <http://www.c8sciencepanel.org/index.html>.

<sup>35</sup> Int'l Agency for Research on Cancer, Monograph: Perfluorooctanoic Acid (updated Dec. 22, 2016), <https://monographs.iarc.fr/iarc-monographs-on-the-evaluation-of-carcinogenic-risks-to-humans-6/>.

<sup>36</sup> U.S. ENVTL. PROT. AGENCY, Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA), EPA DOC. NO. 822-R-16-005, at 24 (May 2016), [https://www.epa.gov/sites/production/files/2016-05/documents/pfoa\\_health\\_advisory\\_final\\_508.pdf](https://www.epa.gov/sites/production/files/2016-05/documents/pfoa_health_advisory_final_508.pdf); U.S. ENVTL. PROT. AGENCY, Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS), EPA DOC. NO. 822-R-16-004, at 24-25

GenX are less studied, the chemical similarity between those three chemicals to PFOA and PFOS, and the limited existing data, suggests that all five contaminants contribute to increased cancer risk. There is, therefore, no safe threshold of exposure to PFOA, PFOS, PFNA, PFHxS, and GenX. Consistent with the U.S. Environmental Protection Agency's (EPA) approach of setting the Maximum Contaminant Level Goal<sup>37</sup> at zero for chemicals that are known or probable human carcinogens,<sup>38</sup> NRDC recommends a combined Maximum Contaminant Level Goal of zero for PFOA, PFOS, PFNA, PFHxS, and GenX.

In June 2018, the Agency for Toxic Substances & Disease (ATSDR) released a draft toxicological profile for PFAS. The draft profile falls short of setting Minimal Risk Levels for PFOA and PFOS that are most protective of human health. For PFOS, the ATSDR profile identifies immunotoxicity as the most sensitive endpoint – the most sensitive human health effect for a given exposure route and duration – but stops short of using immunotoxicity to generate a Minimal Risk Level. Similarly, the ATSDR profile fails to consider delayed mammary gland development as the most sensitive endpoint for PFOA. ATSDR does not recognize delayed mammary gland development as an adverse health effect despite evidence that exposure may lead to difficulty in breastfeeding and/or an increase in susceptibility to breast cancer later in life.<sup>39</sup> Were these endpoints used to derive Minimal Risk Levels, they would result in a Maximum Contaminant Level Goal of less than 1 ppt respectively for PFOA and PFOS.

Additionally, a review of the best technologies available for detection and treatment of PFAS establishes that a detection sensitivity of below 1 ppt and a reporting limit of 2 ppt are achievable for PFOA, PFOS, PFNA and PFHxS and detection sensitivity of below 2 ppt

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(May 2016), [https://www.epa.gov/sites/production/files/2016-05/documents/pfos\\_health\\_advisory\\_final\\_508.pdf](https://www.epa.gov/sites/production/files/2016-05/documents/pfos_health_advisory_final_508.pdf).

<sup>37</sup> Under section 1412 of the Safe Drinking Water Act, the EPA regulates drinking water contaminants by first setting a Maximum Contaminant Level Goal based on health effects data. The Maximum Contaminant Level Goal is the maximum level of a contaminant in drinking water at which no known or anticipated adverse effect on the health of persons would occur, allowing an adequate margin of safety.

<sup>38</sup> See 56 Fed. Reg. 20, 3532-33 (Jan. 30, 1991).

<sup>39</sup> M.B. Macon & S.E. Fenton, *Endocrine Disruptors and the Breast: Early Life Effects and Later Life Disease*, 18 J. MAMMARY GLAND BIOL. NEOPLASIA 1, 43-61 (2013).

and a reporting limit of 5 ppt is achievable for GenX<sup>41,42</sup> with EPA Method 537.<sup>43</sup> (EPA Method 537, a detection methodology, is currently used by DEQ in Michigan’s statewide survey of PFAS in community water systems.)<sup>44</sup> As such, NRDC recommends a Maximum Contaminant Level of 2 ppt for combined concentrations of PFOA, PFOS, PFNA, and PFHxS, a Maximum Contaminant Level of 5 ppt for GenX consistent with the federal framework for promulgating Maximum Contaminant Levels at a level as close as possible to the Maximum Contaminant Level Goal. A statutorily-recognized<sup>45</sup> filtration technique, granular activated carbon (GAC), has been demonstrated to remove PFOA, PFOS, PFNA and PFHxS to below detection levels and other treatment technologies show promise as well;<sup>46</sup> thus, a feasible technology exists to allow water systems to meet the proposed Maximum Contaminant Levels. These Maximum Contaminant Levels would also be the standard “necessary to protect public health,” under Michigan state law.<sup>47</sup>

There is growing evidence that PFAS as a class collectively pose similar threats to human health and the environment. The PFAS class of chemicals is characterized by extreme persistence, high mobility, and is associated with a multitude of different types of toxicity at very low levels of exposure. The 2014 Helsingør and 2015 Madrid Statements, founded on extensive reviews of the scientific literature, provided consensus from more than 200 scientists on the adverse health risks associated with the PFAS class.<sup>48</sup> Several adverse health outcomes have been reported for other PFAS in both animal and human studies.

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<sup>41</sup> see [http://greensciencepolicy.org/wp-content/uploads/2017/12/Andy\\_Eaton\\_UCMR3\\_PFAAS\\_data.pdf](http://greensciencepolicy.org/wp-content/uploads/2017/12/Andy_Eaton_UCMR3_PFAAS_data.pdf). and

[https://cfpub.epa.gov/si/si\\_public\\_record\\_Report.cfm?dirEntryId=343042&Lab=NERL](https://cfpub.epa.gov/si/si_public_record_Report.cfm?dirEntryId=343042&Lab=NERL)

<sup>42</sup> Per the updated EPA Method 537.1, the detection limit for the GenX compound HFPO-DA is 1.9 ppt and the LCMRL is 4.3 ppt, however reporting limits for PFAS detection methods have consistently decreased as lab capabilities improve and we believe that a reporting limit of 2 ppt should be achievable in the near future. When this occurs the Maximum Contaminant Level for GenX should also be set at 2 ppt.

<sup>43</sup> See Env’tl. Prot. Agency, EPA Drinking Water Research Methods (updated Nov. 27, 2018), <https://www.epa.gov/water-research/epa-drinking-water-research-methods>.

<sup>44</sup> See, e.g., Mich. Dep’t Env’tl. Quality, PFAS Sampling Guidance (2018), [https://www.michigan.gov/pfasresponse/0,9038,7-365-86510\\_87154-469832--,00.html](https://www.michigan.gov/pfasresponse/0,9038,7-365-86510_87154-469832--,00.html).

<sup>45</sup> The Safe Drinking Water Act states that “granular activated carbon is feasible for the control of synthetic organic chemicals, and any technology, treatment technique, or other means found to be the best available for the control of synthetic organic chemicals must be at least as effective in controlling synthetic organic chemicals as granular activated carbon.” 42 U.S.C. §300g-1.

<sup>46</sup> Structurally similar PFAS to PFOA and PFOS, such as GenX, are anticipated to be comparably removed by GAC, though more frequent monitoring and GAC regeneration may be required for certain PFAS to ensure adequate removal. Other treatment technologies such as ion exchange, nanofiltration and reverse osmosis are also options that should be explored.

<sup>47</sup> See MICH. COMP. LAWS § 325.1005(1)(b).

<sup>48</sup> M. Scheringer *et al.*, *Helsingør Statement on Poly- and Perfluorinated Alkyl Substances (PFASs)*, 114 CHEMOSPHERE, 337-339 (2014); A Blum *et al.*, *The Madrid Statement on Poly- and Perfluoroalkyl Substances (PFASs)*, 123 ENVTL. HEALTH PERSP. 5, A107-A111 (2015).

These include increased serum lipids (PFDeA), decreased antibody response (PFDeA, PFUA and PFDoA), liver and/or kidney damage (PFBS, PFHxA, and PFUA), decreased body weight (PFDoA, PFDeA, and PFUA), endocrine disruption (PFDeA, PFBS, and PFBA), developmental toxicity (PFDeA, PFHxA, PFUA, PFDoA, PFBS, and PFBA), reproductive toxicity (PFBS), and effects on blood (PFUA, PFBS, and PFBA), similar to findings for PFOA, PFOS, PFNA, and PFHxS.

Therefore, the class collectively poses a threat to human health and the environment and a Maximum Contaminant Level Goal of zero should be set for the class to protect public health and avoid a “whack a mole” problem whereby dangerous PFAS are swiftly replaced by one another and regulatory action fails to keep pace. A Treatment Technique for the class should be set within two years, based on the best detection and treatment technologies available. The state should, as part of the process, evaluate analytical techniques, including TOPA,<sup>49</sup> to help measure the concentration of non-discrete and difficult to measure PFAS compounds.

NRDC commends Michigan for initiating a statewide survey of drinking water sources. We recommend that Michigan expedite its current statewide survey of drinking water sources and conduct additional rounds of testing, to validate results. In addition to public water systems, DEQ should offer testing of drinking water from private wells in or proximate to areas where elevated PFAS levels have been identified. DEQ should test all public water systems for the full suite of PFAS contaminants. NRDC also recommends that Michigan conduct a comprehensive health assessment of residents in Michigan communities found to have elevated PFAS concentrations in drinking water.

Fetal exposure to PFAS may occur during pregnancy through placental transfer. For infants, PFAS blood serum levels may be further elevated due to ingestion of mothers’ contaminated breastmilk or formula prepared with PFAS-contaminated water. PFAS concentrations in breastmilk are much higher than what is typically found in drinking water. For example, breastmilk PFOA levels are estimated to be approximately 5 times higher than drinking water PFOA concentrations ingested by the mother.<sup>50</sup> Therefore, Michigan should mandate provision of public education materials to residents served by contaminated water supplies, and to physicians, regarding special risks posed to pregnant women and to infants.

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<sup>49</sup> Total oxidizable precursor assay (TOP assay or TOPA) is a method employing indirect measurement that more comprehensively assesses the range of PFAS contamination of a sample. Erika F. Houtz & David L. Sedlak, Oxidative Conversion as a Means of Detecting Precursors to Perfluoroalkyl Acids in Urban Runoff, 46 *Envtl. Science & Tech.* 17 9342-49 (2012). *See* Test America, PFAS Total Oxidizable Precursor (TOP) Assay, <https://www.testamericainc.com/services-we-offer/services-we-offer-by-method-group/ultra-trace-level-organics/pfas-total-oxidizable-precursor-top-assay/> (last visited Dec. 4, 2018).

<sup>50</sup> MINNESOTA DEP’T OF HEALTH, Toxicological Summary for: Perfluorooctanoate (Aug. 2018).

Such materials should contain information pertaining to the vulnerability of infants and pregnant women to PFAS exposure. Breastfeeding women exposed to elevated PFAS in drinking water should be advised of the benefits and risks of breastmilk, whether use of bottled water or a filter is recommended, and be provided with information to discuss with their family doctor and pediatrician.

## **V. EPA's Efforts to Regulate PFAS Have Been Inadequate to Safeguard Public Health**

Despite established scientific evidence that PFAS pose unacceptable human health risks, EPA has repeatedly stopped short of setting enforceable regulatory standards for the contaminants. In 2009, EPA placed PFOA and PFOS on a list of unregulated contaminants known or anticipated to occur in public water systems, that may require regulation under the Safe Drinking Water Act.<sup>51</sup> Three years later, in 2012, EPA listed certain PFAS as “unregulated contaminants” under EPA’s Third Unregulated Contaminant Monitoring Rule.<sup>52</sup> Accordingly, EPA required large public water systems to conduct some monitoring for six PFAS, including PFOA, PFOS, PFHxS, and PFNA, as well as PFBA and PFHpA, from 2013 to 2015, and to notify EPA if levels exceeded established thresholds.<sup>53</sup> A small percentage of small water systems also conducted EPA-funded monitoring for the chemical. However, around the country, only 800 public wells serving less than 10,000 people were selected for random testing by EPA. The vast majority of villages and small towns were not tested under this rule. Public water systems detecting any level of PFAS were not required by EPA to notify the public or remediate the contamination. EPA subsequently excluded PFAS contaminants from the Fourth Unregulated Contaminant Monitoring Rule in 2017 without initiating a rulemaking process to set a national primary drinking water standard.<sup>54</sup>

EPA set a non-binding, non-enforceable drinking water “health advisory” for combined levels of PFOA and PFOS at 70 ppt in May 2016.<sup>55</sup> However, compliance with

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<sup>51</sup> 42 U.S.C. § 300g-1(b); *see also* U.S. ENVTL. PROT. AGENCY, Contaminant Candidate List 3 - CCL, <http://www.epa.gov/ccl/contaminant-candidate-list-3-ccl-3> (last visited Aug. 15, 2018).

<sup>52</sup> U.S. ENVTL. PROT. AGENCY, Third Unregulated Contaminant Monitoring Rule, <http://www.epa.gov/dwucmr/third-unregulated-contaminant-monitoring-rule> (last visited Aug. 15, 2018).

<sup>53</sup> *See* 40 C.F.R. § 141.40; *see also* Revisions to the Unregulated Contaminant Monitoring Regulation (UCMR 3) for Public Water Systems, 77 Fed. Reg. 26072 (May 2, 2012).

<sup>54</sup> Revisions to the Unregulated Contaminant Monitoring Rule (UCMR 4) for Public Water Systems and Announcement of Public Meeting, 81 Fed. Reg. 92666 (Dec. 20, 2016).

<sup>55</sup> U.S. ENVTL. PROT. AGENCY, Drinking Water Health Advisory, Perfluorooctanoic Acid (PFOA), EPA DOC. NO. 822-R-16-005 (May 2016), [https://www.epa.gov/sites/production/files/2016-05/documents/pfoa\\_health\\_advisory\\_final\\_508.pdf](https://www.epa.gov/sites/production/files/2016-05/documents/pfoa_health_advisory_final_508.pdf); U.S. ENVTL. PROT. AGENCY, Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS), EPA DOC. NO. 822-R-16-004 (May 2016),

EPA's advisory is purely voluntary. As EPA notes, the advisories serve merely as "non-regulatory technical guidance," not as enforceable standards.<sup>56</sup> Because not all public water suppliers were required to test their water or report their findings under EPA's prior, limited monitoring requirements, and since the federal testing requirements only applied from 2013 to 2015, we still do not know how systematic or severe PFAS contamination is around the country.

Earlier this year, EPA and the White House reportedly attempted to block the release of the Agency for Toxic Substances & Disease Registry's (ATSDR) draft toxicological profile for PFAS showing adverse health effects from exposure to PFOA, PFOS, PFNA and PFHxS at far lower levels than EPA had previously acknowledged. The draft profile was released after a public outcry.<sup>57</sup> But even this development has not prompted EPA to meaningfully regulate these chemicals. Further, as explained in more detail in NRDC's forthcoming report, ATSDR's draft profile underestimates the proper Minimal Risk Levels for PFOA, PFOS, and PFNA. Notwithstanding EPA's announcement of a cross-agency effort to address PFOA and PFOS,<sup>58</sup> there is no indication that any federal agency intends to set an enforceable standard regulating the presence of PFAS in drinking water in the foreseeable future.<sup>59</sup> EPA's present regulatory posture towards PFAS remains woefully insufficient to protect public health.

## **VI. Several States Have Taken Affirmative Action to Fill the Regulatory Gap on PFAS in Drinking Water**

In the absence of robust federal regulation, several states have established or put forth draft Maximum Contaminant Levels or taken other steps to fill the regulatory gap. For

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available at [https://www.epa.gov/sites/production/files/2016-05/documents/pfos\\_health\\_advisory\\_final\\_508.pdf](https://www.epa.gov/sites/production/files/2016-05/documents/pfos_health_advisory_final_508.pdf).

<sup>56</sup> Peter C. Grevatt, DIR., OFFICE OF GROUND WATER & DRINKING WATER, Memorandum, Clarification About the Appropriate Application of the PFOA and PFOS Drinking Water Health Advisories 1 (Nov. 15, 2016), available at [https://www.epa.gov/sites/production/files/2016-11/documents/clarification\\_memo\\_pfoapfos\\_dw\\_has.pdf](https://www.epa.gov/sites/production/files/2016-11/documents/clarification_memo_pfoapfos_dw_has.pdf).

<sup>57</sup> See Report: *White House, EPA Sought to Block Release of Water Pollution Study*, CBS NEWS (May 15, 2018), <https://www.cbsnews.com/news/white-house-epa-sought-to-block-release-of-chemical-pollution-study-report-says/>; Garret Ellison, *EPA's 'Safe' PFAS Level is 6 Times Too High*, MLIVE (May 14, 2018), [https://www.mlive.com/news/index.ssf/2018/05/politico\\_pfas\\_atsdr\\_epa\\_levels.html](https://www.mlive.com/news/index.ssf/2018/05/politico_pfas_atsdr_epa_levels.html).

<sup>58</sup> Press Release, EPA Launches Cross-Agency Effort to Address PFAS, EPA (Dec. 4, 2017), <https://www.epa.gov/newsreleases/epa-launches-cross-agency-effort-address-pfas>.

<sup>59</sup> EPA's so-called PFAS Management Plan, promised by "Fall 2018," is not expected to include any actual proposed drinking water standards. The agency has taken over 7 years since it made a formal regulatory determination that perchlorate should be regulated in drinking water, and still has not even proposed a standard for that chemical. Michigan should not wait for EPA action on PFAS drinking water standards which will be many, many years in coming, if they are ever issued.

example, New Jersey, in November 2017, recommended Maximum Contaminant Levels for PFOA at 14 ppt and PFOS at 13 ppt.<sup>60</sup> New Jersey recently also formally adopted a Maximum Contaminant Level for PFNA at 13 ppt.<sup>61</sup> Vermont has established a drinking water health advisory for combined concentrations of PFOA, PFOS, PFHxS, PFNA and PFHpA at 20 ppt.<sup>62</sup> Minnesota has published drinking water guidance levels for PFOA and PFOS at 35 ppt and 27 ppt, respectively.<sup>63</sup> California has recommended an interim notification level of 14 ppt for PFOA, and 13 ppt for PFOS in drinking water.<sup>64</sup>

Michigan, too, must act to protect drinking water, reduce risks to the public, and investigate and remediate drinking water systems known to be contaminated with these health-threatening chemicals. The prevalence of PFAS in Michigan's drinking water compels the swift adoption of a stringent combined Maximum Contaminant Level for PFOA, PFOS, PFNA, and PFHxS, for GenX, and regulation of the class of PFAS within two years. These actions are necessitated by the severe, adverse health effects linked to PFAS exposure, the extended period that the chemicals remain in water absent filtration, and the contaminants' long half-lives, which contribute to continued elevated blood serum levels even after exposure has ceased. Michigan's current groundwater cleanup standard of 70 ppt for PFOA and PFOS – adopting EPA's flawed advisory level – is both insufficiently

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<sup>60</sup> Katie Jennings, *DEP Adopts Tough Limits for PFOA Contamination in Drinking Water*, POLITICO N.J. PRO (Nov. 1, 2017), <https://www.politicopro.com/states/new-jersey/story/2017/11/01/dep-adopts-tough-limits-forpfoa-contamination-in-drinking-water-115413>.

<sup>61</sup> Scott Fallon, *New Jersey Becomes First State to Regulate Dangerous Chemical PFNA in Drinking Water*, NJ.com (Sept. 6, 2018), <https://www.northjersey.com/story/news/environment/2018/09/06/new-jersey-first-state-regulate-dangerous-chemical-pfna-pfoa/1210328002/>.

<sup>62</sup> Vermont Dep't of Health, *Memorandum from Mark A. Levine, Commissioner, to Emily Boedecker, Commissioner, Drinking Water Health Advisory for Five PFAS (per- and polyfluorinated alkyl substances)* (July 10, 2018), [http://www.healthvermont.gov/sites/default/files/documents/pdf/ENV\\_DW\\_PFAS\\_HealthAdvisory.pdf](http://www.healthvermont.gov/sites/default/files/documents/pdf/ENV_DW_PFAS_HealthAdvisory.pdf).

<sup>63</sup> Minn. Dep't of Health, *Toxicological Summary for: Perfluorooctanoate* (Aug. 2018), <http://www.health.state.mn.us/divs/eh/risk/guidance/gw/pfoa.pdf>; Minn. Dep't of Health, *Toxicological Summary for: Perfluorooctane Sulfonate* (May 2017), <http://www.health.state.mn.us/divs/eh/risk/guidance/gw/pfoa.pdf>.

<sup>64</sup> Cal. Office of Env'tl. Health Hazard Assessment, *Memorandum from Lauren Zelise, Director, to Darrin Polhemus, Deputy Director. Div. of Drinking Water State Water Resources Control Board, Recommendation for Interim Notification Levels for Perfluorooctanoic Acid (PFOA) and Perfluorooctane Sulfonate (PFOS)* (June 26, 2018), [https://www.waterboards.ca.gov/drinking\\_water/certlic/drinkingwater/documents/pfos\\_and\\_pfoa/OEHHA\\_Recommended\\_Int\\_NL\\_Jun\\_26\\_2018.pdf](https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/pfos_and_pfoa/OEHHA_Recommended_Int_NL_Jun_26_2018.pdf).

protective of human health and fails to fully address the state's many drinking water systems contaminated by these dangerous chemicals.

## **VII. Conclusion**

As described above, a forthcoming report prepared for the state of Michigan by Anna Reade, Ph.D. and Judith Schreiber, Ph.D., will examine the scientific basis for these recommendations in greater detail. An accompanying cover letter will also detail deficiencies in the existing regulatory framework for PFAS, both federally and in Michigan, and will set forth the legal basis for taking the recommended regulatory actions.

Please do not hesitate to contact us if you wish to discuss these recommendations further.

Sincerely,

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