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conservation law foundation

For a thriving New England

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October 25, 2018

Julia S. Moore, Secretary
Vermont Agency of Natural Resources
1 National Life Drive, Davis 2
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Re: Petition for Rulemaking to Establish a Treatment Technique Drinking Water Standard for Per- and Polyfluoroalkyl Substances

Dear Secretary Moore:

Conservation Law Foundation (CLF), Vermont Natural Resources Council (VNRC), Rights and Democracy (RAD), Vermont Public Interest Research Group (VPIRG), and Toxics Action Center (hereinafter Petitioners) hereby petition the Vermont Agency of Natural Resources (Agency) to establish a drinking water standard for Per- and Polyfluoroalkyl Substances (PFAS) that is protective of public health.[1] Specifically, Petitioners request the Agency to adopt a treatment technique drinking water standard for the PFAS class of chemicals in lieu of setting a maximum contaminant level (MCL) for specific PFAS. At a bare minimum, if the Agency does not promulgate a treatment technique standard, the Agency should adopt an MCL for the PFAS class or MCLs for each PFAS chemical that poses a risk to public water systems in Vermont. As an interim step to protect public health, the Agency should immediately adopt the Vermont Department of Health's (VDH) Health Advisory (Health Advisory) as an MCL.[2] PFAS have been found in drinking water sources across Vermont and numerous studies have linked PFAS to significant health risks, including cancer. Although the State of Vermont has taken preliminary steps to limit exposure to this dangerous class of chemicals, the Agency must take additional affirmative steps to protect Vermonters from PFAS.

CLF protects New England's environment for the benefit of all people. Founded in 1966, CLF is a non-profit, member-supported organization with offices located in Vermont, Massachusetts, Rhode Island, Maine, and New Hampshire. CLF uses the law, science, and the market to create

[1] Pursuant to Vermont's Administrative Procedure Act, codified at 3 V.S.A. §806, any person may submit a written request to an agency asking the agency to adopt a rule. Within 30 days of receiving the request, the agency must either initiate rule-making proceedings or shall deny the request, giving its reasons in writing.
[2] Although this petition has prioritized a drinking water standard for the PFAS class, there is also an urgent need to develop comprehensive standards for PFAS compounds, including but not limited to, surface water quality standards, pre-treatment standards for industrial users, and limits for land application of sludges.

solutions that protect public health, preserve natural resources, build healthy communities, and sustain a vibrant economy. CLF has been a leading advocate for clean water and safe drinking water in Vermont and throughout New England, and is engaged in numerous efforts to address the threat of emerging contaminants like PFAS throughout New England.

Through research, education, collaboration and advocacy, VNRC protects and enhances Vermont's natural environments, vibrant communities, productive working landscapes, rural character and unique sense of place, and prepares the state for future challenges and opportunities.

RAD's mission is to bring people together to take action to build healthy communities and make community values guide the policies of government. RAD works in partnership with community groups, progressive unions, faith communities, organizations fighting for human and civil rights, and environmental and climate action groups.

VPIRG is the largest nonprofit consumer and environmental advocacy organization in Vermont, with over 50,000 members and supporters. For over 45 years, VPIRG has brought the voice of average Vermont citizens to public policy debates concerning the environment, health care, consumer protection and democracy.

Founded in 1987, Toxics Action Center works side-by-side with communities across New England to clean up and prevent pollution at the local level.

Introduction

The Agency must immediately adopt a drinking water standard that protects Vermonters from exposure to unsafe levels of all PFAS compounds. PFAS are persistent in the environment; bioaccumulative; highly mobile in water; found in hundreds of different products; and are toxic in very small concentrations. PFAS have been found at unsafe levels in drinking water in Vermont, as well as in ground- and surface waters. Drinking water contaminated with PFAS is a significant source of exposure.[3] Without a drinking water standard, public water systems in Vermont are not required to regularly monitor for PFAS compounds or to treat water with unsafe levels of PFAS.

DuPont, 3M, and other chemical manufacturers recklessly produced these dangerous chemicals for decades despite being aware of the significant health risks associated with PFAS. Furthermore, in 1981, 3M and DuPont were aware that ingestion of perfluorooctanoic acid (PFOA) caused birth defects in rats.[4] After receiving this information, DuPont tested seven children of pregnant workers: two had birth defects.[5]

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[3] *See* Vt. Dep't of Health, *Health Department Releases PFOA Blood Test and Exposure Assessment Results*, Jan. 26, 2017,http://www.healthvermont.gov/sites/default/files/documents/2017/01/NEWS_PFOA%20Blood%20Test%20%26%20Exposure%20Assessment%20Results.pdf (noting that "PFOA levels in blood were strongly correlated with PFOA levels in well water.").

[4] Nathaniel Rich, *The Lawyer Who Became DuPont's Worst Nightmare*, N.Y. TIMES, Jan. 6, 2016, https://www.nytimes.com/2016/01/10/magazine/the-lawyer-who-became-duponts-worst-nightmare.html.

[5] *Id.*

DuPont was also aware that at least one facility had contaminated local drinking water supplies with unsafe levels of PFOA by 1991, but failed to warn anyone.[6]

DuPont hid this vital health information from the public and the U.S. Environmental Protection Agency (EPA) while making billions of dollars in profits from continued production of PFOA.[7] Ultimately, DuPont was fined $16.5 million dollars in 2005 for failing to disclose information about toxicity and health risks cause by PFOA.[8] Although PFOA and perfluoro-octane sulfonic acid (PFOS) have now been phased out of production in the U.S.,[9] these compounds will remain in our drinking water, ground- and surface waters, as well as our bodies, for decades. In addition, manufacturers have rushed to produce thousands of alternative PFAS that are likely to pose similar health risks given the similarities in chemical structure.[10] There are now over 3,000 different kinds of PFAS.

To make matters worse, EPA has failed to take meaningful action to protect the public from exposure to PFAS in drinking water. After becoming aware of contamination of drinking water supplies and the significant health risks posed by these dangerous chemicals, EPA gave manufacturers almost a decade to phase out production and use of PFOA and PFOS through a voluntary program.[11] Despite learning in 2015 that millions of Americans were, and continue to be, exposed to PFAS-contaminated drinking water, EPA has not taken steps toward requiring public water systems to regularly monitor for PFAS and to treat unsafe water.[12] EPA even suppressed a scientific study suggesting that EPA's current health advisory for PFOA and PFOS does not protect public health.[13]

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[6] *Id.*
[7] *Id*.
[8] Memorandum from Grant Y. Nakayama, Assistant Administrator, to Environmental Appeals Board Re Consent Agreement and Final Order to Resolve DuPont's Alleged Failure to Submit Substantial Risk Information Under the Toxic Substances Control Act (TSCA) and Failure to Submit Data Requested Under the Resource Conservation and Recovery Act (RCRA) (Dec. 14, 2005), https://www.epa.gov/sites/production/files/2013-08/documents/eabmemodupontpfoasettlement121405.pdf.
[9] U.S. Envtl. Prot. Agency, *Assessing and Managing Chemicals Under TSCA, Fact Sheet: 2010/2015 PFOA Stewardship Program*, https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/fact-sheet-20102015-pfoa-stewardship-program#what.
[10] *See, e.g.*, Stephen Brendel et al., *Short-Chain Perfluoroalkyl Acids: Environmental Concerns and a Regulatory Strategy under REACH*, 30 ENVTL. SCI. EUR. 9 (2018), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5834591/pdf/12302_2018_Article_134.pdf.
[11] *See, e.g.*, U.S. Envtl. Prot. Agency, *In the matter of: Premanufacture Notice Numbers: Dupont Company*, April 9, 2009, https://assets.documentcloud.org/documents/2746607/Sanitized-Consent-Order-P08-0508-and-P08-0509.pdf.; Premanufacture Notification Exemption for Polymers; Amendment of Polymer Exemption Rule to Exclude Certain Perfluorinated Polymers, 75 Fed. Reg. 4295, 4296 (Jan. 27, 2010).
[12] David Andrews, *Report: Up to 110 Million Americans Could Have PFAS-Contaminated Drinking Water*, ENVTL. WORKING GROUP, May 22, 2018, https://www.ewg.org/research/report-110-million-americans-could-have-pfas-contaminated-drinking-water#.W6_7a2hKg2w.
[13] Abraham Lustgarten, et al., *Suppressed Study: the EPA Underestimated Dangers of Widespread Chemicals*, PROPUBLICA, June 20, 2018, https://www.propublica.org/article/suppressed-study-the-epa-underestimated-dangers-of-widespread-chemicals.

After widespread public outcry, EPA announced the possibility of setting drinking water standards for just two out of more than 3,000 PFAS, but no enforceable regulatory standard has been proposed to date, and even this limited action will take years.[14]

In addition, the federal government's capacity to set a standard protective of public health has been compromised by the staggering liabilities of the United States for releases of PFAS at federal facilities nationwide.

Vermont can—and must—take the lead in the absence of federal safeguards. We will never be able to reverse the damage caused by chemical manufacturers and EPA's inaction, but the Agency has broad authority to promulgate rules that limit additional exposure to unsafe levels of PFAS in drinking water.[15] In the absence of such rules, the public will remain at risk, and the most vulnerable among us—nursing infants and children generally, who consume higher volumes of water for their body weight and have greater developmental susceptibility—will be at the greatest risk.

Moreover, in the absence of such rules, homeowners on well-water and municipalities and other drinking water system operators will be stymied in their efforts to recover the costs of adopting filtration and other safeguards from responsible polluters.

For all of these reasons, the Agency should stop putting public health at risk and adopt a treatment technique drinking water standard that will protect Vermonters from the class of PFAS. As an interim step, the Agency should immediately adopt the current Health Advisory for PFAS as a drinking water standard for public water systems.

I. Background

A. PFAS are harmful to human health.

PFAS are a public health crisis "perfect storm" because PFAS compounds are extremely persistent in the environment, highly mobile in water, bioaccumulative, toxic in very small quantities, and found in hundreds of products. PFAS compounds are man-made substances that do not occur naturally, and they have been used in non-stick cookware, water-repellent clothing, stain resistant fabrics and carpets, cosmetics, firefighting foams, and other products that resist grease, water, and oil.[16] These chemicals are extremely strong and highly resistant to degradation.[17]

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[14] *The Federal Role in the Toxic PFAS Chemical Crisis, Hearing on SD-342 Before the Subcomittee. on Homeland Security & Governmental Affairs*, 115th Cong. (2018) (statement of Chairman Rand Paul and Ranking Member Gary C. Peters), https://www.hsgac.senate.gov/hearings/the-federal-role-in-the-toxic-pfas-chemical-crisis.
[15] 10 VT. STAT. ANN. tit. 10, § 1672(b)(1).
[16] Seth Kerschner & Zachary Griefen, *Next Round of Water Contamination Suits May Involve CWA*, LAW 360, October 5, 2017, https://www.law360.com/articles/970995/next-round-of-water-contamination-suits-may-involve-cwa.
[17] New Jersey Dep't of Envtl. Prot. Division of Science, Research, and Envtl. Health, *Investigation of Levels of Perfluorinated Compounds in New Jersey Fish, Surface Water, and Sediment*, June 18, 2018,

PFAS are toxic to humans in very small concentrations—in the *parts per trillion* (ppt).[18] PFAS are suspected carcinogens and have been linked to growth, learning and behavioral problems in infants and children; fertility and pregnancy problems, including pre-eclamsia; interference with natural human hormones; increased cholesterol; immune system problems; and interference with liver, thyroid, and pancreatic function.[19] PFAS have been linked to increases in testicular and kidney cancer in human adults.[20] The developing fetus and newborn babies are particularly sensitive to some PFAS.[21]

Alarmingly, epidemiological studies identify the immune system as a target of PFAS toxicity. Some studies have found decreased antibody response to vaccines, and associations between blood serum PFAS levels and immune system hypersensitivity (asthma) and autoimmune disorders (ulcerative colitis).[22] There are no medical interventions that will remove PFAS from the body.[23]

PFAS "have been detected in all environmental media including air, surface water, groundwater (including drinking water), soil, and food."[24] A study by the Centers for Disease Control and Prevention (CDC) found four PFAS (PFOS, PFOA, perfluorohexane sulfonic acid (PFHxS), and perfluorononanoic acid (PFNA)) in the serum of nearly all of the people tested, indicating widespread exposure in the U.S. population.[25] PFOA and PFOS were found in up to 99 percent of the U.S. general population between 1999 and 2012.[26] PFAS are found in human breast milk and umbilical cord blood.[27]

While a great deal of public attention has recently been paid to PFOA and PFOS, and VDH recently issued a Drinking Water Health Advisory for five PFAS compounds (PFOA, PFOS, perfluoroheptanoic acid (PFHpA), PFNA, PFHxS), EPA and other scientists have raised concerns that other chemicals in the PFAS class of compounds are similar in chemical structure

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https://www.nj.gov/dep/dsr/publications/Investigation%20of%20Levels%20of%20Perfluorinated%20Compounds%20in%20New%20Jersey%20Fish,%20Surface%20Water,%20and%20Sediment.pdf.

18 Agency for Toxic Substances and Disease Registry, *Per- and Polyfluoroalkyl Substances (PFAS) and Your Health*, https://www.atsdr.cdc.gov/pfas/health-effects.html; Agency for Toxic Substances and Disease Registry, *Toxicological Profile for Perfluoroalkyls*, https://www.atsdr.cdc.gov/toxprofiles/tp200.pdf, at 5–6.

19 Agency for Toxic Substances and Disease Registry, *Toxicological Profile for Perfluoroalkyls*, https://www.atsdr.cdc.gov/toxprofiles/tp200.pdf, at 5–6.

20 *Id.* at 6; Vaughn Barry et al., *Perfluorooctanoic Acid (PFOA) Exposures and Incident Cancers among Adults Living Near a Chemical Plant*, 121 ENVTL. HEALTH PERSPECTIVES 11-12, 1313-18 (Nov.-Dec. 2013), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3855514/pdf/ehp.1306615.pdf.

21 U.S. Envtl. Prot. Agency, *Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS)*, (May 2016), https://www.epa.gov/sites/production/files/2016-05/documents/pfoa_health_advisory_final_508.pdf, at 10.

22 *Id.* at 39.

23 Vermont Dep't of Health, *Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS) in Drinking Water*, July 9, 2018, http://www.healthvermont.gov/sites/default/files/documents/pdf/ENV_DW_PFAS.pdf.

24 Agency for Toxic Substances and Disease Registry, *Toxicological Profile for Perfluoroalkyls*, *supra* note 18, at 2.

25 Ctr. for Disease Control and Prevention, *Per- and Polyfluorinated Substances (PFAS) Factsheet* (Apr. 7, 2017), https://www.cdc.gov/biomonitoring/PFAS_FactSheet.html.

26 U.S. Envtl. Prot. Agency, *Drinking Water Health Advisory for Perflourooctanoic Acid (PFOA)* (May 2016) at 9, https://www.epa.gov/sites/production/files/2016-05/documents/pfoa_health_advisory_final_508.pdf.

27 Agency for Toxic Substances and Disease Registry, *Toxicological Profile for Perfluoroalkyls*, *supra* note 18, at 3.

and are likely to pose similar health risks.[28] For example, all PFAS share a strong carbon-flourine bond and "degrade very slowly, if at all, under environmental conditions."[29] Although some of the long-chain PFAS are being regulated or phased out, the most common replacements are short-chain PFAS with similar structures, or compounds with fluorinated segments joined by ether linkages.[30] While some shorter-chain fluorinated alternatives seem to be less bioaccumulative, they are still as environmentally persistent as long-chain substances or have persistent degradation products.[31] In addition, because some of the shorter-chain PFAS are less effective, larger quantities may be needed to provide the same performance.[32] Thus, drinking water rules must protect the public health from unsafe exposure to all compounds in the PFAS class.

B. PFAS have been found in Vermont drinking water, groundwater, and surface waters.

Not only are PFAS toxic in very small amounts (in the nanograms per liter or ppt), they are highly mobile in groundwater and surface water, and have been found in waters throughout Vermont.

1. Drinking Water

In February 2016, the Agency's Department of Environmental Conservation (DEC) discovered widespread PFAS contamination in over 400 drinking water wells in Bennington County, Vermont, 300 of which had contamination levels greater than the state's PFAS Health Advisory of 20 ppt.[33] Alarmingly, the highest level of PFOA detected in a private drinking water well was 4,600 ppt.[34]

DEC conducted further sampling throughout Vermont near known sources of PFAS, and found the following:

- In the Town of Pownal, near a former wire coating facility and a tannery superfund site, a contaminated public water well supplying water to 400 people measured above the PFAS Health Advisory.[35] DEC also found 30 private drinking water wells in Pownal that were

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[28] *See, e.g.*, U.S. Envtl. Prot. Agency, *supra* note 11 (stating that, with respect to "GenX" compounds (chemical substances intended to replace long-chain (C8) PFAS used in Teflon), "EPA has concerns that these PMN substances will persist in the environment, could bioaccumulate, and be toxic ("PBT") to people, wild mammals, and birds.").
[29] Arlene Blum et al., *The Madrid Statement on Poly- and Perfluoroalkyl Substances (PFASs)*, ENVTL. HEALTH PERSPECTIVES (May 2015), https://ehp.niehs.nih.gov/doi/pdf/10.1289/ehp.1509934.
[30] *Id. See also*, KEMI Swedish Chemicals Agency, *Occurrence and use of highly fluorinated substances and alternatives; Report from a government assignment*, 6-78, 26 (August 9, 2009), https://www.kemi.se/en/global/rapporter/2015/report-7-15-occurrence-and-use-of-highly-fluorinated-substances-and-alternatives.pdf.
[31] Blum, *supra* note 29.
[32] *Id.*
[33] Vt. Dep't of Envtl. Conservation, *Perfluoroalkyl Substances (PFAS) Contamination Status Report*, (July 2018), at 2, https://dec.vermont.gov/sites/dec/files/documents/PFAS%20Sampling%20Report%207.10.18%20FINAL.pdf.
[34] *Id.* at 2.
[35] *Id.* at 3.

similarly contaminated with elevated levels of PFAS.[36] One well contained PFAS levels at more than five times the allowable limit.[37]

- At the Southern Vermont Airport in Clarendon, three private residential water supply wells and a public drinking water system with two bedrock wells serving the Rutland Business Park were contaminated with PFAS above the PFAS Health Advisory.[38]
- A drinking water supply near the Shaftsbury Landfill was contaminated with PFAS above the PFAS Health Advisory.[39]

PFAS have also been found at elevated levels in drinking water at Vermont schools. For example, sampling conducted by DEC at the Grafton Elementary School revealed PFAS concentrations at 22 ppt, which is above the Health Advisory.[40] In addition, PFAS was also detected at Eden Central School at 5.3 ppt.[41]

Finally, earlier sampling conducted by EPA at the former Kocher Drive Dump in Bennington as part of a national PFAS testing effort detected PFAS above the PFAS Health Advisory in four overburden monitoring wells, as well as one offsite private supply well, and an offsite geothermal well.[42]

2. Groundwater

DEC's PFAS investigation also found levels of contamination above the PFAS Health Advisory in groundwater at or near the following locations:

- A wire coating facility in Colchester (Champlain Cable facility);[43]
- A former wire coating operation in Shelburne;[44]
- A battery manufacturing facility in St. Albans;[45] and
- A groundwater recovery trench at the Air National Guard site in South Burlington, where Aqueous Film-Forming Foam Concentrations (AFFF) fire-fighting foam containing PFAS was used.[46]

Elevated levels of PFAS were also found in groundwater at several landfill sites in Bennington and Windham Counties. Specifically, the Burgess Brothers C&D landfill, Putney Paper sludge

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[36] *Id.*
[37] *Id.*
[38] *Id.* at 6.
[39] *Id.* at 8.
[40] Jim Therrien, *School water tests provide encouraging results*, VT DIGGER, Aug. 17, 2018, https://vtdigger.org/2018/08/17/school-water-tests-provide-encouraging-results/.
[41] *Id.*
[42] Vt. Dep't of Envtl. Conservation, *supra* note 33, at 8.
[43] *Id.* at 4.
[44] *Id.*
[45] *Id.* at 5.
[46] *Id.* at 6.

landfill, Shaftsury MSW landfill, and Halifax landfill reported groundwater concentrations above the PFAS Health Advisory.[47]

PFAS have also been detected in the sludge of wastewater treatment facilities (WWTF). Sludge sample results from the Bennington WWTF showed PFOA and PFOS at an average concentration of 7 and 8 µg/kg (parts per billion or ppb), respectively.[48] The sludge samples were also analyzed using a synthetic precipitation leaching procedure (SPLP) to detect whether PFAS would leach into the groundwater from any sludge that was land-applied. The results of this testing showed PFOA at 68 ppt.[49]

In addition, PFOA sample results from sludge/biosolids at six WWTF that receive leachate from Vermont landfills reached levels of 13 ppb.[50] PFOS concentrations ranged from 5.6 to 17.7 ppb.[51] DEC also analyzed the sludge samples from two specific WWTFs, South Burlington-AP and Burlington-Main, using SPLP.[52] The results detected PFOA at concentrations ranging from 4.99 and 4.25 ppt, respectively, and PFOS at 22.7 and 3.34 ppt, respectively.[53]

Finally, PFAS was also detected in some samples of septage from residential septic tanks in Bennington in May and June of 2016.[54] Typical septic systems are not equipped to filter PFAS before water seeps through, thus these PFAS are likely to eventually reach groundwater sources.[55]

3. Surface Water

PFAS are also present at elevated levels in surface waters throughout Vermont due to several exposure pathways. First, PFAS can end up in surface waters based on proximity to PFAS-emitting facilities, like the former ChemFab site in Bennington. In its investigation, DEC found PFAS in surface waters, sediment, and fish tissue samples collected in Bennington, most likely due to contamination from airborne particles of PFAS from the former ChemFab plant.[56] Likewise, sludge sampled from Bennington's WWTF (which likely received PFAS through contaminated discharges associated with the former ChemFab facility), showed presence of

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[47] *Id.* at 8.
[48] *Id.* at 11.
[49] *Id.*
[50] *Id.* at 12-13.
[51] *Id.* at 13.
[52] *Id.*
[53] *Id.*
[54] *Id.* at 12.
[55] *See* Schaider et al., *Septic systems as sources of organic wastewater compounds in domestic drinking water wells in a shallow sand and gravel aquifer*, 547 SCIENCE OF THE TOTAL ENVIRONMENT(March 2016), at 470-481 ("Incomplete degradation or sorption during treatment in septic tanks and leach fields, as well as leaks of poorly treated sewage from aging and failing systems, allow some [organic wastewater compounds ("OWCs"), including PFAS] to percolate through vadose zone soils and enter groundwater. Some OWCs can persist during subsurface transport and end up in groundwater (Swartz et al., 2006, Phillips et al., 2015), surface water (Standley et al., 2008, Dougherty et al., 2010) and drinking water (Verstraeten et al., 2005, Schaider et al., 2014.)"), https://ac.els-cdn.com/S0048969715312353/1-s2.0-S0048969715312353-main.pdf?_tid=f51656d8-e7bb-4ef9-96d7-bff90ce97736&acdnat=1540398848_cd07935c02cf0a79c8151a72e785b2ac.
[56] Vt. Dep't of Envtl. Conservation, *supra* note 36, at 11.

PFAS.[57] Because the Bennington WWTF is not designed to remove PFAS (as discussed below), this PFAS contamination eventually ends up in surface waters.

Second, PFAS are present in landfill leachate that is discharged to surface waters via a WWTF. Landfill leachate is the liquid pollutant resulting from water moving through the waste pile of a landfill. DEC found elevated levels of PFAS in the leachate of every landfill in Vermont that has an active leachate collection system, with the highest concentrations at the New England Waste Services of VT (NEWSVT) active landfill.[58]

While leachate gets collected and processed along with wastewater at WWTFs before being discharged to surface waters, this does not mean PFAS are removed. To the contrary, according to DEC, "it is not uncommon to observe higher concentrations of some PFAS in the [wastewater] effluent, then [sic] are observed in the influent."[59]

II. The Agency should establish a treatment technique drinking water standard for the PFAS class that is protective of human health.

In the absence of federal safeguards, Vermont must act to protect drinking water and limit Vermonters' exposure to PFAS. As described below, setting MCLs on a chemical-by-chemical basis does not adequately protect Vermonters from PFAS health impacts; nor does Vermont's current approach for investigating PFAS contamination. Instead, a treatment technique drinking water standard for the class of PFAS is needed. This regulatory approach is authorized by law and technically feasible.

A. The chemical-by-chemical, MCL approach to regulating toxic chemicals is not protective of public health and the environment.

The current chemical-by-chemical regulatory framework for toxic chemicals is so inefficient it puts public health at risk. For example, even after the 2016 amendment to the Toxic Substances Control Act (TSCA), "it could take decades to evaluate the 80,000 chemicals already in commerce that have yet to be tested, let alone the 2,000 new chemicals introduced each year." [60] The EPA "still treats each chemical individually, continuing the saga in which similar, but slightly different, chemicals can be regrettably substituted."[61]

This "whack-a-mole" approach is especially troublesome when it comes to setting drinking water standards for emerging contaminants like PFAS, because it is time consuming and expensive to assess them, it is "technically and financially challenging to identify and reverse environmental and human exposure to PFASs[,]" and both of these

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[57] *Id.*
[58] *Id.* at 9.
[59] *Id.* at 12.
[60] Joseph Allen, *Stop playing whack-a-mole with hazardous chemicals*, WASH. POST, December 15, 2016, https://www.washingtonpost.com/opinions/stop-playing-whack-a-mole-with-hazardous-chemicals/2016/12/15/9a357090-bb36-11e6-91ee-1adddfe36cbe_story.html?utm_term=.ba3a5ab70fce.
[61] *Id.*

issues are exacerbated by the continual introduction of new PFAS compounds.[62] There are at least 3,000 PFAS compounds in use currently[63] and regulators don't know the names of all PFAS compounds, much less where they are located in their state. Recently developed PFAS are regarded as trade secrets and closely-guarded confidential business information, so manufacturers often do not apply for patents or supply regulators with information about molecular structure or usage.[64]

In light of the thousands of PFAS that have been introduced into commerce, and more introduced each year, establishing MCLs for each PFAS compound is simply not sustainable. The regulators fall farther behind every year, putting our citizens in harm's way. Thus, Vermont should adopt a treatment technique drinking water standard that protects Vermonters from exposure to unsafe levels of all chemicals in the PFAS class.

B. The current Health Advisory does not protect Vermonters.

Vermont's current Health Advisory for PFAS does not protect Vermonters from exposure to unsafe PFAS levels in public water systems. Even though Vermont has issued a Health Advisory for PFAS, public water systems in Vermont are not required to test for and treat unsafe concentrations of PFAS because there is no federal or state drinking water standard for any of the PFAS compounds. In August of 2018, VDH issued a revised Drinking Water Health Advisory for five PFAS compounds (PFOA, PFOS, PFHpA, PFNA, PFHxS).[65] The Agency has also promulgated an emergency rule to establish the Health Advisory for PFAS as a groundwater quality enforcement standard, which means that persons releasing any of the five PFAS into groundwater at concentrations greater than 20 ppt are responsible for cleaning up contamination.[66] However, the Agency has yet to adopt the Health Advisory for these five PFAS as an MCL or to establish an alternative drinking water standard for PFAS, which means that public water systems in Vermont are not required to monitor for or treat unsafe concentrations of PFAS. But, even if the Health Advisory was adopted as an MCL, it would not be protective of public health because it does not address the thousands of PFAS chemicals in the PFAS class.

Further, the Agency's approach to investigating potential PFAS contamination in public water systems is flawed. According to Vermont's 2016 guidance document on PFOA in drinking water, Vermont does not expect PFOA "to be a state-wide problem affecting many water systems."[67] This guidance is based on monitoring conducted by EPA in 2013 as part of EPA's Unregulated Contaminant Monitoring Rule (UCMR-3). Yet these results are not sufficient to assess the potential presence of PFAS in public water systems because (1) only ten out of more

[62] Zhanyun Wang et al., *A Never-Ending story of Per- and Polyfluoroalkyl Substances (PFASs)*?, ENVTL. SCIENCE & TECH., (February 22, 2017) at 2511, https://pubs.acs.org/doi/pdf/10.1021/acs.est.6b04806.
[63] *KEMI Swedish Chemicals Agency, supra* note 30, at 6.
[64] *Id.* at 26.
[65] Vt. Dep't of Health *supra* note 23.
[66] *Id.*
[67] Vt. Dep't of Envtl. Conservation, Drinking Water and Groundwater Protection Division, *Guidance Re Perfluorooctanoic Acid (PFOA) in Drinking Water*, http://dec.vermont.gov/sites/dec/files/documents/pfoa_dw_guidance3.30.2016.pdf.

than 413[68] public water systems in Vermont were tested for just six PFAS and (2) the reporting limits for the UCMR-3 Rule were significantly higher than the Health Advisory for PFAS, ranging from 10 ppt to 90 ppt.[69] For example, the minimum reporting level for PFOS for the UCMR-3 sampling event was 40 ppt, which is well above the *combined* 20 ppt Health Advisory.[70] The high reporting limits means that it is impossible for the Agency to know the full extent of PFAS contamination in Vermont.[71]

Moreover, DEC's summary conclusion that PFOA contamination is limited to areas near certain manufacturing processes is unsupported. PFAS contamination sources include firefighting and fire suppression training areas, food packaging, wire coatings and insulation, plastics, landfills, car washes, domestic sewage and septic systems, wastewater treatment plants, ski areas, outdoor textiles and sporting equipment, cleaning agents and fabric softeners, paints, windshield wipers, medical products and facilities, and potentially many others.[72] The State's recommendation to only test a small fraction of public water supplies located near a small selection of industrial manufacturing sites is woefully inadequate.

C. A treatment technique drinking water standard is appropriate for PFAS.

The Agency has broad authority to regulate unsafe chemicals in drinking water.[73] In this case, the unique nature of PFAS demands an alternative approach to chemical-by-chemical regulation through MCLs. Regulation of PFAS as a class and through a treatment technique standard is necessary. There are well-established drinking water treatment technologies that public water systems can install to remove unsafe levels of PFAS from drinking water. There is simply no excuse for the Agency to delay the promulgation of a drinking water standard for the PFAS class to address this public health crisis "perfect storm."

1. The Agency has the authority to adopt a treatment technique drinking water standard.

The Agency has authority to adopt a treatment technique drinking water standard for PFAS. Pursuant to 10 V.S.A. § 1672, the Secretary "shall regulate" drinking water "to prevent and

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[68] Vt. Dep't of Envtl. Conservation, *Consumer Confidence Reports*, http://dec.vermont.gov/water/drinking-water/public-drinking-water-systems/ntncws/consumer-confidence-reports.
[69] Vt. Dep't of Envtl. Conservation, Drinking Water and Groundwater Protection Division, *supra* note 67; U.S. Envtl. Prot. Agency, *Monitoring Unregulated Drinking Water Contaminants, Third Unregulated Contaminant Monitoring Rule*, https://www.epa.gov/dwucmr/third-unregulated-contaminant-monitoring-rule.
[70] Vt. Dep't of Envtl. Conservation, Drinking Water and Groundwater Protection Division, *supra* note 67 (emphasis added).
[71] In a May 2018 report, the Environmental Working Group suggested that the reporting limits for the UCMR-3 Rule likely dramatically underestimated the number of Americans drinking water with unsafe levels of PFAS. *Supra* note 12.
[72] See, e.g., Int'l Tech. Regulatory Council, *History and Use of Per- and Polyfluoroalkyl Substances (PFAS)*, https://pfas-1.itrcweb.org/wp-content/uploads/2017/11/pfas_fact_sheet_history_and_use__11_13_17.pdf.
[73] 10 VT. STAT. ANN., § 1672(a).

minimize public health hazards."[74] The Secretary has broad authority to establish "standards or requirements for drinking water quality" so long as the standards or requirements are at least as stringent as the national primary drinking water regulations.[75] The Water Supply Rule does not expressly provide for how the Agency should establish drinking water standards other than stating that the Secretary may adopt a Health Advisory Level set by VDH as an MCL.[76]

"A treatment technique is an enforceable procedure or level of technological performance which public water systems must follow to ensure control of a contaminant."[77] Where a treatment technique is selected in lieu of an MCL, the treatment technique must "prevent known or anticipated adverse effects on the health of persons to the extent feasible."[78] EPA has adopted several treatment technique drinking water standards in lieu of an MCL where EPA has determined that it is "not economically or technologically feasible to ascertain the level of [a] contaminant."[79] For example, the Lead and Copper Rule is a treatment technique.[80] This rule requires public water systems to test drinking water in the homes of consumers and undertake additional treatment measures to control lead if 10 percent of the samples exceed 15 ppb.[81] The Surface Water Treatment Rule is also a treatment technique.[82] Under this rule, most public water systems that obtain water from surface water or groundwater under the direct influence of surface water must use filters and disinfectants to reduce pathogens.[83] In both cases, EPA had to establish a unique procedure to address the risks posed by a specific contaminant because an MCL would not have been practical or protective of public health due to the unique characteristics of the contaminants.

Similarly, the unique characteristics of the PFAS class pose a public health threat that cannot be adequately addressed with the establishment of an MCL for one or a few PFAS chemicals. The Agency has the authority to develop a procedure that would require installation of specific drinking water treatment technologies under certain circumstances. The Agency has multiple options to protect Vermonters from exposure to the PFAS class. For example, the Agency could

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[74] 10 VT. STAT. ANN., § 1672(a). The State of Vermont has primacy for the Safe Drinking Water Act in Vermont and has adopted the authority of the Safe Drinking Water Act via rulemaking. Vt. Dep't of Envtl. Conservation, *Vermont Water Supply Rule, Subchapter 21-1.*

[75] 10 VT. STAT. ANN., § 1672(b)(1). Several of the national primary drinking water standards are treatment technique rules. U.S. Envtl. Prot. Agency, *How EPA Regulates Drinking Water Contaminants*, https://www.epa.gov/dwregdev/how-epa-regulates-drinking-water-contaminants (citing Surface Water Treatment Rule, Lead and Copper Rule, and Acrylamide and Epichlorohydrin Rules). The Safe Drinking Water Act authorizes the Administrator to establish a treatment technique standard in lieu of a maximum contaminant level "if the Administrator makes a finding that it is not economically or technologically feasible to ascertain the level of the contaminant." 42 U.S.C. § 300g-1(b)(7)(A).

[76] Vt. Dep't of Envtl. Conservation, *Vermont Water Supply Rule, Subchapter 21-6 § 6.15.*

[77] U.S. Envtl. Prot. Agency, *How EPA Regulates Drinking Water Contaminants*, https://www.epa.gov/dwregdev/how-epa-regulates-drinking-water-contaminants.

[78] 42 U.S.C. § 300g-1(b)(7)(A).

[79] *Id.*

[80] U.S. Envtl. Prot. Agency, *How EPA Regulates Drinking Water Contaminants, supra* note 77.

[81] U.S. Envtl. Prot. Agency, *Lead and Copper Rule*, https://www.epa.gov/dwreginfo/lead-and-copper-rule.

[82] U.S. Envtl. Prot. Agency, *How EPA Regulates Drinking Water Contaminants, supra* note 77.

[83] U.S. Envtl. Prot. Agency, *Surface Water Treatment Rules, https://www.epa.gov/dwreginfo/surface-water-treatment-rules*.

promulgate a rule that requires public water systems to install appropriate treatment technologies where (1) the sum of all measurable PFAS exceeds a conservative threshold level that is protective of public health and takes into account the cumulative impacts of all PFAS chemicals, or (2) the presence of PFAS compounds is detected using "non-targeted" laboratory analysis.[84] An alternative option would be to require a robust source water assessment for PFAS and require treatment where PFAS may be present in the source water. The Agency should determine a specific procedure for the drinking water standard through a robust stakeholder process as part of the rulemaking process.

2. Due to the unique characteristics of the PFAS class of compounds, a treatment technique is necessary to protect public health.

i. Regulation of PFAS chemicals as a class is necessary.

Even if the Agency were to adopt the current Health Advisory as an MCL, 20 ppt for five PFAS would not protect Vermonters from the 3,000 or more other PFAS.[85]

VDH guidance sets forth a process for regulating multiple chemicals together to protect public health. "For chemicals that do not have established toxicity values from authoritative sources but are part of a group of chemicals in which one or more chemicals do have toxicity values, a single Health Advisory may be developed that is applicable to the sum of multiple contaminants, including chemicals that do not have toxicity values."[86] VDH has already acknowledged that combined regulation of at least five PFAS (PFOA, PFOS, PFHxS, PFHpA, and PFNA)—even where toxicity values for some compounds are not available—is appropriate because these five compounds satisfy four criteria: (1) they are "currently being investigated in Vermont and have been found in drinking water," (2) they are all "members of the PFAS family . . . and are considered sufficiently similar," (3) they "are often found together," and (4) they "elicit similar health effects . . . ."[87]

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[84] EPA and other scientists have identified "non-targeted" laboratory testing methods to better investigate PFAS contamination. *See, e.g.*, U.S. Envtl. Prot. Agency, *EPA Researchers Use Innovative Approach to Find PFAS in the Environment*, https://www.epa.gov/sciencematters/epa-researchers-use-innovative-approach-find-pfas-environment (noting that non-targeted analysis allows "researchers [to] rapidly characterize thousands of never studied chemical compounds in a wide variety of environmental, residential, and biological media); Karl Leif Bates, *Duke Expert Helps Spearhead State's New Water-Testing Program*, DUKE TODAY, Aug. 8, 2018, https://today.duke.edu/2018/08/duke-expert-helps-spearhead-states-new-water-testing-program (noting that non-targeted analysis is used on the Rhine River in Europe, a drinking water source for 20 million people, to monitor emerging contaminants daily).

[85] KEMI Swedish Chemicals Agency, *Occurrence and use of highly fluorinated substances and alternatives; Report from a government assignment*, *supra* note 30, at 6.

[86] *See, e.g.*, Vermont Dep't of Health, *Drinking Water Guidance*, *Grouping Process for Drinking Water Health Advisories*, Aug. 24, 2018, http://www.healthvermont.gov/sites/default/files/documents/pdf/ENV_ECP_GeneralScreeningValues_Water.pdf.

[87] Memorandum from Mark A. Levine, Commissioner, Vermont Dep't of Health, to Emily Boedecker, Commissioner, Vermont Dep't of Envtl. Conservation Re 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; *see also*

The same four criteria are met with respect to the class of PFAS compounds. First, in addition to PFOA, PFOS, PFHxS, PFHpA, and PFNA, other PFAS that have been found or are being investigated in Vermont, including, for example, perfluorobutane sulfonic acid (PFBS), perfluorohexanoic acid (PFHxA), perfluoroundecanoate (PFUnA), perfluorodecanoic acid (PFDA), perfluorododecanoic acid (PFDoA), perfluorotridecanoate (PFTriA), and perfluorotetradecanoic acid (PFTeA).[88] There are likely many other PFAS in Vermont that the State of Vermont is simply not aware of yet given the speed and secrecy with which chemical manufacturers have introduced these dangerous chemicals into commerce.[89]

Second, as discussed in Section I.A above, PFAS are similar in chemical structure and some PFAS break down into each other. While long-chain PFAS compounds may be decreasing in the environment due to voluntary phase-outs by manufacturers, "the most common replacements are short-chain PFAS with similar structures."[90] Third, these PFAS chemicals are often found together, and fourth, they are likely to have similar health effects, as discussed in Section I.A.

EPA has applied similar concepts to establish an MCL for a group of chemicals.[91] For example, EPA established an MCL for five haloacetic acid disinfection byproducts (HAA5) because it did not have sufficient information regarding (1) the occurrence of individual haloacetic acids; (2) how water quality parameters affect the formation of haloacetic acids; (3) how "treatment technologies control the formation of individual . . . [haloacetic acids]; and (4) toxicity information for some of the individual haloacetic acids.[92] In light of the unique challenges associated with regulation of these chemicals, EPA promulgated a group MCL even in the absence of complete information about each individual haloacetic acid in order to better protect public health.[93] For all these reasons, it is appropriate to regulate PFAS chemicals as a class.

ii. A treatment technique in lieu of an MCL is necessary.

A treatment technique in lieu of an MCL for specific PFAS chemicals or small groups of PFAS chemicals is necessary. As discussed previously, scientists suspect that PFAS chemicals in the class may have similar adverse health effects as the handful of PFAS compounds that have been studied more extensively.[94] EPA has only developed targeted test methods for 14 PFAS

Vermont Dep't of Health, *Drinking Water Guidance*, Attachment 4 at 2 (August 24, 2018), http://www.healthvermont.gov/sites/default/files/documents/pdf/ENV_ECP_GeneralScreeningValues_Water.pdf.

[88] Vt. Dep't of Envtl. Conservation, Information for Impacted Communities, Clarendon, https://dec.vermont.gov/commissioners-office/pfoa/communities#Clarendon.

[89] Envtl. Working Group, *Environmental Working Group Comments on the Agency for Toxic Substances and Disease Registry (ATSDR) Draft Toxicological Profile for Perfluoroalkyls* August 20, 2018, https://cdn.ewg.org/sites/default/files/testimony/EWG%20Comments%20for%20ATSDR_Aug20..pdf?_ga=2.236461961.949885036.1539136763-1789323056.1527870942.

[90] Blum et al. *supra* note 29.

[91] Vt. Dep't of Health, *supra* note 86.

[92] 63 Fed. Reg. 69390, 69409 (Dec. 16, 1998), https://www.gpo.gov/fdsys/pkg/FR-1998-12-16/pdf/98-32887.pdf#page=1.

[93] *Id.*

[94] KEMI Swedish Chemicals Agency, *supra* note 30.

chemicals out of more than 3,000 compounds.[95] Thus, it is simply not economically or technically feasible to ascertain the level of each specific PFAS chemical in the PFAS class that poses a risk to Vermonters.

As the Agency is well aware, establishing an MCL for one compound is resource intensive and time consuming. Adopting a treatment technique drinking water standard for the PFAS class in lieu of establishing MCLs for thousands of PFAS chemicals will require far fewer Agency resources and will provide protection from exposure to unsafe levels of PFAS on a much shorter timeline. For all of these reasons, a treatment technique drinking water standard is necessary to protect Vermonters.

3. Treatment technologies are available to remove long- and short-chain PFAS.

There are both established and novel methods to remove and destroy PFAS. While long- and short-chain PFAS may be difficult to treat with any one traditional technology—some new technologies are in development—, a "treatment train" of several technologies combining adsorbtion, separation, and destruction in sequence, for example, would be effective in treating drinking water and protecting public health.

Adsorbtion technologies such as granular activated carbon (GAC) and ion exchange "are currently the most commonly encountered interim response measures to achieve immediate compliance with drinking water standards and serve as the benchmark of practicality and effectiveness for other treatment technologies."[96]

While new adsorbtion technologies like organically modified silica adsorbents show promise,[97] GAC has long been used for adsorbtion of chemical pollutants, consistently removes PFOS with an efficiency of more than 90 percent,[98] and is the treatment technique specified in the Safe Drinking Water Act (SDWA) for the control of synthetic organic chemicals:

> 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.[99]

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[95] U.S. Envt. Prot. Agency, *Method 537: Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography /Tandem Mass Spectrometry* 537-2 (EPA/600/R-08/092) (Sep. 2009), http://citeseerx.ist.psu.edu/viewdoc/download;jsessionid=ED20973987CE8E7A0E0944E8E31D66BE?doi=10.1.1.645.8401&rep=rep1&type=pdf.

[96] J. Horst et al., *Water Treatment Technologies for PFAS: The Next Generation,* 38 GROUNDWATER MONITORING & REMEDIATION (Spring 2018), at 15.

[97] *Id.* at 15–16.

[98] K.H. Kucharzyk et al., *Novel treatment technologies for PFAS compounds: a critical review* 204 JOURNAL OF ENVTL. MANAGEMENT (December 2017), at 759; 42 U.S.C. § 300g-1(b)(4)(D), 759.

[99] 42 U.S.C. § 300g-1(b)(4)(D).

Separation technologies, including reverse osmosis, microfiltration, ultrafiltration and nanofiltration, are highly effective for PFAS removal and can remove PFAS at more than 99 percent effectiveness.[100] "Membrane filtration has several benefits including: achieving continuous separation, low energy consumption, ease of combination with other existing techniques, easy up-scaling, and low chemical costs."[101] Ozofractionation (a patented process by the company EVOCRA and available commercially as Ozofractionative Catalyzed Reagent Addition (OCRA)) is a novel separation technology that shows high (greater than 99.99 percent reduction) effectiveness for PFAS.[102]

Finally, novel destructive treatment technologies for PFAS are becoming available. Destructive technologies include sonochemical decomposition,[103] chemical/advanced photochemical oxidation,[104] and AECOM's DE-FLUORO™ technology.[105]

This treatment train solution will also confer significant co-benefits for public health, because the same technologies that are effective in PFAS treatment are effective in removing a host of other dangerous chemicals. GAC adsorbtion filters alone, for example, are effective in removing dozens of harmful contaminants in addition to PFAS (including, but not limited to: RDX, arsenic, benzene, cryptosporidium, MTBE, mercury, perchlorate, tetrachloroethylene (Perc), and trichloroethylene (TCE)).[106] Other technologies that should be considered as components of the treatment train confer similar co-benefits; for example, membrane separation technologies like reverse osmosis not only treat PFAS but, without limitation, also treat 1,4-dioxane, alachlor, chromium, malathion, and nitrates.[107]

For all these reasons, Petitioners urge the Agency to initiate a rulemaking for a treatment technique drinking water standard for the PFAS class.

III. In the alternative, the Agency should either adopt an MCL for the PFAS class or for each individual PFAS chemical.

The Agency must take action to establish drinking water standards for PFAS in the absence of federal safeguards even if the Agency does not establish a treatment technique standard. As discussed in Section II.C, the Agency has the authority to regulate PFAS as a class or on a chemical-by-chemical basis. PFAS are present in Vermont waters and are known to cause adverse health effects. Thus, at a bare minimum, the Agency should either adopt an MCL for the

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[100] Kucharzyk et al., *supra* note 98 at 759–60; Horst, supra note 96.
[101] V.A. Arias Espana et al., *Treatment technologies for aqueous perfluorooctanesulfonate (PFOS) and perfluorooctanoate (PFOA): A critical review with an emphasis on field testing*, ENVIRONMENTAL TECHNOLOGY & INNOVATION (2015), at 168, 177.
[102] Horst, *supra* note 96, at 17.
[103] Espana, *supra* note 101, at 174.
[104] *Id.* at 178.
[105] AECOM, *AECOM's Promising New PFAS Treatment Technology DE-FLUORO Shows Complete Destruction of PFAS*, https://www.aecom.com/content/wp-content/uploads/2018/04/PFAS-Treatment-Technology-DE-FLUORO_INFO-SHEET.pdf.
[106] U.S. Envtl. Prot. Agency, *Drinking Water Treatability Database*, *Granular Activated Carbon*, https://oaspub.epa.gov/tdb/pages/treatment/treatmentContaminant.do.
[107] *Id.*

PFAS class or for each individual PFAS chemical that poses a risk to public water systems in Vermont.

IV. The Agency should immediately adopt the Health Advisory as a maximum contaminant level.

In the interim and until the Agency establishes a treatment technique drinking water standard for PFAS, the Agency should immediately adopt the Health Advisory as an MCL. For contaminants which may be detected in a public water system for which MCLs have not been adopted, and the Health Commissioner has established a Health Advisory Level for the compound, the Secretary may adopt the Advisory Level as an MCL.[108] For example, the Secretary adopted the VDH Health Advisory for nickel as an MCL.[109] In this case, VDH has established a Health Advisory of 20 ppt total for PFOA, PFOS, PFHxS, PFHpA, and PFNA combined.[110] The Secretary should immediately adopt these as MCLs.

CONCLUSION

For all the forgoing reasons, Petitioners request the Agency establish a drinking water standard for PFAS that is protective of public health. Specifically, the Agency should adopt a treatment technique drinking water standard for the PFAS class. In the alternative, the Agency should establish an MCL for the PFAS class or individual MCLs for each PFAS chemical that poses a risk to public water systems in Vermont. As an interim step, the Agency should immediately adopt the Health Advisory as an MCL.

The significant threats posed to human health and the environment by the PFAS class of compounds are clear. These compounds have been found in Vermont drinking water, groundwater, and surface waters. The dangers this class of chemicals pose to Vermonters demand immediate action to limit further exposure. Thank you for your consideration.

Sincerely,

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[108] Vt. Dep't of Envtl. Conservation, *Vermont Water Supply Rule, Subchapter 21-6 § 6.15* (December 1, 2010).
[109] *Id. Subchapter 21-6 § 6.12* (December 1, 2010).
[110] *Id.*

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