



PROPOSED PUBLIC WATER SUPPLY SAMPLING PLAN

For Contaminants with a Vermont Health Advisory – May 2020

A Plan to Sample for Chemicals with a Vermont Health Advisory

As required by Act 21 (2019), Section 10(b), the Secretary of the Agency of Natural Resources, on or before January 1, 2020, must publish for public review and comment a plan to collect data for contaminants in drinking water from public community water systems and all non-transient non-community water systems, for which a health advisory has been established, but no Maximum Contaminant Level has been adopted.

These health advisories are referred to as Vermont Health Advisories (VHAs) in this document.

TABLE OF CONTENTS

I.	Executive Summary	Page 3
II.	Background	Page 4
III.	Determining the VHA contaminants for sampling at public water systems	Page 6
IV.	Sampling Considerations	Page 10
V.	Proposed Sampling Plan	Page 12

Attachments

Table 1	Complete List of Vermont Health Advisories (VHAs)	Page 13
Table 2	Proposed List of VHAs with Potential Concern	Page 18

I. Executive Summary

The Secretary of the Agency of Natural Resources was tasked with developing a sampling plan for public review, for certain drinking water contaminants that have an established health advisory, also known as the Vermont Health Advisory (VHA) but have no Maximum Contaminant Level (MCL). This Sampling Plan (Plan) is targeted to public community and public non-transient non-community water systems. To provide context for public water system regulation, and standards that apply, a discussion of how VHAs and MCLs are determined is given.

Recognizing that testing for all 175 chemicals on the VHA list would cost each water system tens of thousands of dollars to conduct for each water system, the ANR sought a scientifically defensible way to tailor sampling while also assuring adequate public health protection. Criteria were applied to focus on contaminants that potentially could be present at levels above the VHA, in sources of water for Vermont's public water systems. Among these criteria were known use or presence of the contaminant, and whether 1) drinking water methods exist to detect the contaminant, and 2) if they do exist, can they detect at the VHA level. In addition, it was found that many of the contaminants (100 of the 175) are already monitored by public water systems. This is due to testing laboratories expanding the number of chemicals that can be found with EPA-approved methodologies beyond those required for regulatory purposes.

Applying the above criteria reduced the list of potential contaminants not previously sampled from 175 contaminants to 43 for Phase 1 of the Plan and this report. For Phase 2 of the Plan, the ANR recommends further refinement to determine which of the 43 should be monitored at any given public water system. Among these water system-specific criteria are a hydrogeologic evaluation and land use patterns around the source(s). A source-specific hydrogeologic evaluation would be conducted to determine if there are geologic features such as low permeability layers and groundwater flow direction away from a potential source of contamination. In addition, land uses surrounding each water source would be evaluated in concert with the hydrogeological analysis to determine the likelihood of a VHA contaminant reaching the water supply. Sampling would need to occur at water systems with a likely risk of having that chemical present and with no mitigating geologic features. The attached Plan identifies the actions and resources needed to perform this work.

II. Background

Vermont Health Advisories (VHA) are developed by the Vermont Department of Health when requested by other departments or agencies in Vermont state government. The Agency of Natural Resources (ANR) and the Agency of Agriculture, Food and Markets (AAFM) are two such agencies. The Department of Environmental Conservation (DEC) in the ANR has used VHAs to develop regulatory standards for groundwater protection and AAFM has used them to develop regulatory standards for pesticide control. VHAs have not typically been used to set enforceable standards for public drinking water supplies. The EPA establishes the list of chemicals with MCLs, and public water supplies are dependent on the effectiveness of the EPA program and MCLs to ensure public water system source protection. Public water systems are man-made systems consisting of water sources, pipes, tanks, pumps and other appurtenances. These systems are regularly required to test and report the water quality results, not only for source contaminants but also contaminants in the distribution system.

VHAs are numeric guidelines that are developed after researching the animal toxicological data and human epidemiological data in scientific literature for the levels of a contaminant that may have an adverse human health effect. When developing a drinking water VHA, VDH considers not only ingestion exposure for all chemicals but also inhalation exposure due to household water use for those chemicals that may easily volatilize. VHAs are derived for chemicals with carcinogenic and adverse non-carcinogenic health endpoints, as the scientific literature indicates. If a VHA is exceeded it does not necessarily follow that adverse health effects may occur, but exposure should be minimized while further evaluation of the water supply is conducted. Once the Department of Health has developed a health advisory it is added to a list of chemicals that have VHA values. (See attached Table 1.) This list is found on the Department of Health's website, but with the columns for MCL and VAL removed for clarity in application of this Plan. In this Plan, the updated VHA list of May 3, 2019 was used. VDH has no regulatory framework to implement and require compliance with the VHAs they determine, and there is no public comment on the process to set VHA. It has become the responsibility of the various programs that adopt the VHA values into their regulations to provide public comment through the rulemaking process, and then once a rule is final, to enforce the standards through their regulatory authorities.

Maximum Contaminant Levels (MCLs) are developed by a different process at the federal level. Once EPA makes a regulatory determination to develop a standard (i.e. a National Public Drinking Water Regulation) the first step is to develop a Maximum Contaminant Level Goal (MCLG). MCLGs are typically set at zero for microbial contaminants and for most carcinogens. MCLGs are

based on Reference Doses (RfDs) for non-cancer health effects. MCLGs will then be used to either set an MCL or a treatment technique (if it is technically infeasible to assess compliance with an MCL). The Safe Drinking Water Act requires the MCL to be set as close to the MCLG as feasible, taking cost into consideration as well as technical feasibility (best available technology or treatment, reliable under field conditions). EPA is also required by the Safe Drinking Water Act to prepare a health risk reduction and cost analysis in support of a National Public Drinking Water Regulation. Where benefits of a new MCL do not justify the costs, EPA may adjust the MCL to a level that “maximizes health reduction benefits at a cost that is justified by the benefits.” These types of evaluations are done by EPA staff who have a unique expertise not available to the states. See this link to EPA <https://www.epa.gov/dwregdev/how-epa-regulates-drinking-water-contaminants> for further information.

Primacy states like Vermont are obligated to adopt EPA regulations. For Vermont to have an enforceable limit prescribed for a specific chemical in a public water system, the DEC would need to propose a Maximum Contaminant Level for inclusion in a Water Supply Rule revision, and it would need to be adopted through Vermont’s formal rule-making process. There is currently no requirement to evaluate the same criteria that EPA does for an MCL (ability to monitor, technical feasibility of treatment, or cost/benefit analysis). The current Vermont Administrative Procedure Act criteria for cost evaluation is focused on small businesses and schools (which can be but are not always public water systems). Cost criteria are not focused on the municipalities which typically are the owners and operators of community public water systems.

Further, the state is obligated to close the funding gap between federal funding and the cost to operate a program that meets both state and federal requirements. Federal funding for state drinking water programs has remained flat for more than a decade.

III. Determining the VHA contaminants for sampling at public water systems.

A. Criteria used to focus the Vermont Health Advisory list (Phase 1 – completed)

Certain criteria were used to evaluate which of the 175 VHAs would be appropriate to be monitored at public water systems (see Table 1 for list of VHAs). The first evaluation of the list revealed that 100 of the 175 chemicals were already analyzed for most public drinking water systems by laboratories as part of current lab methodologies. When analytical labs perform routine synthetic organic compounds (SOCs) or volatile organic compounds (VOCs) for the regulated contaminants that are routinely monitored at public water systems, the EPA approved lab methods include similar chemical compounds in the analytical scan. For example, MTBE (a gasoline additive) does not have an MCL but is monitored whenever a routine VOC is done for Water Supply Rule compliance. In addition, several pesticides are reported by analytical labs already, as part of SOC scans required by Subchapter 6 of the Water Supply Rule.

VHAs also include cyanotoxins and PFAS compounds that have been or are currently being monitored. The presence of cyanotoxins has been analyzed during the last 5 years from public water systems taking drinking water from Lake Champlain. The cyanotoxin testing has focused on microcystin since it is the most common toxin found in Vermont waters. The VT Department of Health and the DEC Drinking Water Program have cooperated in sampling and analyzing raw and finished water from the 22 public water systems that take drinking water from Lake Champlain. However, this sampling has been funded by various unsustainable funding sources. There is no long-term funding for cyanotoxin testing in public drinking water. While Lake Champlain is known to contain blooms of cyanobacteria that release cyanotoxins, and they have been found in raw/lake water near the surface, the toxins have not been found in the drinking water. EPA is requiring a number of non-Lake Champlain water systems using surface water to sample for cyanotoxins as part of the Unregulated Contaminant Monitoring Rule. This monitoring effort, with the current round known as UCMR 4, is underway, and some of the data have been received; no cyanotoxins have been present. However, as lake temperatures increase in Vermont, cyanobacteria blooms are expected to develop or continue in our surface waters. It is not scientifically understood why some cyanobacteria blooms produce toxins while some do not. For this reason, it is important to continue monitoring for cyanotoxins in public drinking water, and cyanotoxins are included for consideration for further sampling.

PFAS compounds are currently being monitored at public water supplies; that is: PFHpA - Perfluoroheptanoic Acid, PFHxS - Perfluorohexane Sulfonic Acid, PFNA - Perfluorononanoic Acid, PFOA - Perfluorooctanoic Acid, and PFOS - Perfluorooctane Sulfonic Acid, and were therefore removed from consideration for further sampling under this Plan.

Following this first analysis and reduction of the number of chemicals needed for further sampling, a second analysis of the remaining list was evaluated to determine if chemicals were unlikely to be found at a public water supply. Several of the chemicals were pesticides that are not used in Vermont now, nor at any other time historically, and so were removed from consideration for potential sampling. This determination was derived from the review of literature and in consultation with the Agency of Agriculture, Food and Markets.

A third analysis evaluated technical feasibility. If any chemical was discovered not to have a drinking water analytical method, it was not considered for monitoring. If a chemical had a drinking water analytical method but could not meet a detection limit at or below the VHA, then it was also not considered. The concern is that if a sample is analyzed, a non-detect would neither prove or disprove the presence of the chemical below the VHA.

Many of the chemicals on the VHA list are pesticides, herbicides, fungicides, and insecticides and registration for them is required for their use in Vermont. Although several of the chemicals are now obsolete, past use could have left a measurable quantity in the environment, and these chemicals remained on the list for consideration for potential sampling.

A few VHAs are naturally present in Vermont's geological material. Boron and molybdenum may occasionally be detected. Boron can have a negative human health effect if consumed in large quantities and can affect the stomach, intestines, liver, kidney, and brain. Excessive molybdenum has been associated with increased occurrence of gout and statistically significant associations were found for the occurrence of high blood pressure. Consequently, these remained on the list for potential sampling and analysis.

Finally, with all these considerations taken into account, 43 chemicals with VHAs were identified for testing that may have been used in Vermont, that have not been previously tested in public drinking water systems on a regular basis, and that have reliable drinking water methods that can be analyzed for levels at or below the Vermont Health Advisory (see Table 2).

B. Criteria for developing a VHA sampling plan (Phase II)

With this list of 43 potential contaminants with VHAs, Phase II of the VHA sampling plan for a given water system would be to evaluate for a given water system the likelihood of detecting these compounds based on land uses and hydrogeologic features. The public water supply program requires Source Protection Plans, that have identified Source Protection Areas and Potential Sources of Contamination. These identified land use patterns can be used to determine the vulnerability of a specific water system, and whether some or all of the chemicals need to be sampled.

Land use activities, the geology, and the local hydrogeology affect the vulnerability of a public water system to chemical contamination. The Source Protection Area (SPA) is a surface and subsurface area from or through which contaminants are reasonably likely to move toward and reach a public water system source. The purpose of delineating a SPA is to determine the most likely recharge area that supplies water to a public water source. The recharge area or SPA for a groundwater source is defined by the nature of subsurface conditions, groundwater flow, and the effects of pumping from wells. Within a SPA, land uses or naturally occurring chemicals may indicate a public water system is vulnerable to contamination; however the geology or groundwater flow may reduce or eliminate that risk.

1. If a specific chemical does not occur in, or was not used in a SPA, then the public water source is not vulnerable to contamination with that particular chemical. Therefore, the water system would not be required to test for it.
2. If there is a natural barrier to that chemical entering the water source such as a confining sediment or bedrock layer, a hydraulic divide, or groundwater movement is away from the water supply and recharge area, then even if the chemical was present in the area, it would be unlikely to reach the source. The water system would not be required to test for it.

Phase II of the Sampling Plan is to review the Source Protection Areas and the accompanying Source Protection Plans to determine if any land uses are found in the SPA that could involve one or more of the VHA chemicals. If the chemical is likely to have been used, then the known geology would be examined for any protective features being present that would prevent movement of the contaminant to the water source. Water sources that have those potential land uses in the SPA and with no naturally protective

features would be listed as vulnerable and need to sample for the associated chemicals. Inconclusive investigations or lack of/limited hydrogeologic data would also result in the need to sample.

Depending on the results of first round of testing, if significant positive results are found, additional tests should be required to be taken at water systems initially found to be exempt. If VHA contaminants are not detected at vulnerable water systems, then no further tests would be done.

IV. Sampling Considerations

A key consideration for this exploratory sampling plan is determining the resources – both human and capital – to carry out the plan. Examination of the source protection area and a water system’s geological context, determining lab capacity for this non-routine sampling, management and logistics of taking the samples, compiling the data and interpreting the results all would require significant time and attention. DEC staff would have the capacity to manage a contract for these services, with appropriate funding, to implement sampling without adversely affecting core regulatory and compliance work to ensure safe drinking water. Diverting staff resources to stand up this program internally would negatively impact the programs ability to meet core drinking water obligations.

The drinking water analytical methods identified for drinking water analysis are those developed by EPA and the USGS and available for use by laboratories. See Table 2 for the identified method for each of the 43 chemicals to be considered. Some chemicals had no known drinking water method for testing and were removed from the list previously. While available for use, these are atypical samples and actual lab capacity needs to be investigated. The lab capacity for these methods will be determined as part of Phase II of the Sampling Plan. There may be few labs, either in state or in the country, able to perform these analyses. This may be a significant hurdle along with individual lab capacity, shipping costs, sample hold times, and modifications to lab equipment to run new methods or revise existing methods. Even with an established EPA method for PFAS, these significant hurdles were definitely present when water systems were performing the Act 21 PFAS monitoring due December 1, 2019.

These methods have a range of cost from \$50 to \$700 for each analysis. If all 43 chemicals are to be sampled, and the average cost is \$400 per sample, the total cost would be approximately \$17,200 per water system (or \$10.3 million if all subject water systems sampled), should public water systems bear the cost. This would be overwhelming for the majority of Vermont’s public water systems. DEC therefore recommends a one-time funding mechanism to cover sampling costs.

Other costs to water systems (municipal entities, schools, offices, etc.) with limited budgets or budgets that need to be voted upon in specific fiscal periods, needs to be evaluated; not just for the cost of sampling but associated costs for response if contaminants are found to exceed the VHA (e.g. treatment installation capital costs and ongoing operation and maintenance). Water systems are

already dealing with the sampling cost and consequences of water sampling results with detection of lead and copper and PFAS and related chemicals. The cost of required treatment, building a treatment facility to house the new treatment, possibly new water lines, removal of contaminated sources or the need to find, develop, and permit new water sources need to be considered.

Staffing to perform the work duties identified in the plan, coordinate with the laboratories and public water systems, manage the reporting of the results, database management, and review and manage water system modifications for the systems with levels above the VHAs will require additional resources. Options include either contracting for services or standing up the program internally with an estimated minimum of 2.0 FTE for a period of two years. Based on the needs for data management, there are also expenses required to create and display a database, house data on state servers, and perform necessary maintenance to both as needed.

V. The Proposed Sampling Plan

The Plan to collect drinking water for contaminant analysis for which a Vermont Health Advisory has been established, but no Maximum Contaminant Level has been adopted.

1. Evaluate land uses in the Source Protection Area to identify potential sources of the VHA chemicals.
2. Evaluate the hydrogeology of the within the SPA for presence or absence of protective geology in the SPA in consultation with a state hydrogeologist or state geologist. Determine whether some or all of the chemicals need to be sampled at each of approximately 600 systems with their own sources.
3. Contact laboratories to determine availability of testing method, hold times, capacity and sample analysis cost.
4. Develop an outreach program to notify systems of sampling requirement, time frame, methodologies, available labs, options available if detects and confirmation samples results are above VHA level, and other pertinent details. Included in this outreach are who and when the samples will be collected for shipment to the analytical lab.
5. Develop a database for compiling sample results for scientific interpretation and sharing with the public.
6. The location for sampling will be at or before the entry point to the distribution system. Some water systems have more than one entry point to distribution, so a sample would be taken at each entry point. A sample will be analyzed for each chemical for which the water system is found to be vulnerable. A confirmation sample will be taken if the chemical is detected above the VHA.
7. For systems that meet or exceed the VHA in an initial and confirmation sample, evaluate options to protect public health. This may include a similar process to that developed for PFAS (replacement source, system operational changes, or treatment).
8. Evaluate funding sources, if available, if treatment or other options are required to address exceedances.

TABLE 1 - Vermont Health Advisories (VHAs) – Update published May 3, 2019 by Vermont Department of Health

Chemical Name	CAS No.	VHA (µg/L) ^(a)
Acetone	67-64-1	949.8
Acifluorfen, sodium	62476-59-9	4.5
Aldicarb	116-06-3	1(b)
Aldicarb sulfone	1646-88-4	1(b)
Aldicarb sulfoxide	1646-87-3	1(b)
Aldrin	309-00-2	0.1
Ametryn	834-12-8	246.8
Aminoethyl ethanolamine (AEEA)	111-41-1	20
Ammonium sulfamate	7773-06-0	914.3
Anatoxin-a	64285-06-9	0.5
Anthracene	120-12-7	342.9
Azoxystrobin	131860-33-8	558.3
Bendiocarb	22781-23-3	1.7
Benefin (Benfluralin)	1861-40-1	5.5
Benomyl	17804-35-2	9.5
Bensulide	741-58-2	15.6
Bentazon	25057-89-0	453.1
Bis(2-chloro-1-methyl ethyl) ether	108-60-1	45.7
Bispyribac sodium	125401-92-5	300.2
Boron	7440-42-8	869.6
Boscalid	188425-85-6	185.7
Bromacil	314-40-9	110.9
Bromochloromethane	74-97-5	7.7
Bromomethane (Methyl bromide)	74-83-9	4.8
Bromoxynil	1689-84-5	1
Butylate	2008-41-5	113.6

Chemical Name	CAS No.	VHA (µg/L) ^(a)
Carbaryl	63-25-2	26
Carboxin	5234-68-4	22.3
Carfentrazone ethyl	128639-02-1	47.9
Chloramben	133-90-4	68.6
Chlorantraniliprole	500008-45-7	5208.6
Chlorflurenol	2536-31-4	457.1
Chlorothalonil	1897-45-6	1.6
Chlorpyrifos	2921-88-2	20
Copper (at tap)	7440-50-8	1300 ^(d)
Cyanazine	21725-46-2	1
Cylindrospermopsin	NA	0.5
Dazomet	533-74-4	88
Diazinon	333-41-5	0.6
Dichlorobenzene (meta)	541-73-1	600 ^(e)
Dichloroethane (1,1)	75-34-3	70
Dichloroprop	120-36-5	140
Dieldrin	60-57-1	0.02
Diethylenetriamine (DETA)	111-40-0	5154
Dimethrin	70-38-2	2000
Dioxane (1,4)	123-91-1	0.3
Diphenamid	957-51-7	200
Disulfoton	298-04-4	0.3
Diuron	330-54-1	10
Erioglaucine	2650-18-2	7211.4
Fenamiphos	22224-92-6	2
Fluoranthene	206-44-0	45.7
Fluorene	86-73-7	45.7
Fluxapyroxad	907204-31-3	44.4
Fonofos	944-22-9	10

Chemical Name	CAS No.	VHA (µg/L) ^(a)
Formaldehyde	50-00-0	1000
Halofenozide	112226-61-6	46
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	0.3
Lead (at tap)	7439-92-1	^{15(d)}
Lead	7439-92-1	1
Maneb	12427-38-2	35
Manganese	7439-96-5	300
Methyl ethyl ketone	78-93-3	510.6
Methyl parathion	298-00-0	2
Methyl tert butyl ether (MTBE)	1634-04-4	11.3
Metolachlor	51218-45-2	70
Microcystin	NA	0.16
Molybdenum	7439-98-7	5.7
Naphthalene	91-20-3	0.5
Nickel	7440-02-0	100
O-Phenylphenol (OPP)	90-43-7	764
Octahydro-1,3,5,7-tetranitro-1,2,3,5,7-tetrazocine (HMX)	2691-41-0	57.1
Paraquat	1910-42-5	30
Pentaerythriol tetranitrate (PETN)	65324	2.3
Perchlorate	1479-73-0	2.2
Perfluoroheptanoic acid (PFHpA)	375-85-9	0.02 ^(g)
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	0.02 ^(g)
Perfluorononanoic acid (PFNA)	375-95-1	0.02 ^(g)
Perfluorooctanesulfonic acid (PFOS)	1763-23-1	0.02 ^(g)
Perfluorooctanoic acid (PFOA)	335-67-1	0.02 ^(g)
Propachlor	1918-16-7	90
Propham	122-42-9	100
Propoxur (Baygon)	114-26-1	6.2

Chemical Name	CAS No.	VHA (µg/L) ^(a)
Radon	010043-92-2	4000 pCi/L ^(h)
Tall oil hydroxyethyl imidazoline	61791-39-7	118
Tartrazine	1934-21-0	1904.8
Tetrachloroethane (1,1,1,2)	630-20-6	70
Triazole (1,2,4)	288-88-0	20
Triazole metabolites (Conjugated)	86362-20-1, 28711-29-7 and Triazolylpyruvic acid	102.9 ⁽ⁱ⁾
Trichlorobenzene (1,2,3)	87-61-6	0.9
Trichlorophenoxyacetic acid (2,4,5)	93-76-5	70
Trichloropropane (1,2,3)	96-18-4	0.02
Triclopyr	55335-06-3	165.3
Trimethyl benzene (1,2,3)	526-73-8	23.2 ^(j)
Trimethyl benzene (1,2,4)	95-63-6	23.2 ^(j)
Trimethyl benzene (1,3,5)	108-67-8	23.2 ^(j)
Trinitrotoluene (2,4,6) (TNT)	118-96-7	0.8
Triticonazole	131983-72-7	194.3
Zineb	142-14-3	350

Notes:

BOLD - value revised from 2002 guidance or added since 2002 list

Value adjusted to reflect analytical laboratory reporting limit

NA - Not Applicable as represents more than one analyte and for microcystin and cylindrospermopsin many congeners may react in the assay

(a) - All units are micrograms per Liter (µg/L) [parts per billion (ppb)] unless otherwise noted

(b) - Sum of Aldicarb, Aldicarb sulfone and Aldicarb sulfoxide not to exceed 1 µg/L.

(c) - EPA 1998 Final Rule for Disinfectants and Disinfection By-products Maximum Residual Disinfection (MRDL)

(d) - Copper and Lead are regulated using "Action Levels" (40CFR141.8)

(e) - Value for meta based on data for ortho dichlorobenzene

(f) - Adjusted excludes Uranium and Radon

- (g) - Sum of PFHpA, PFHxS, PFNA, PFOA and PFOS not to exceed 0.02 µg/L.
- (h)- Water results should be interpreted after air results are obtained
- (i) - Sum of conjugated triazole metabolites (Triazolylalanine, Triazolylacetic acid, and Triazolylpyruvic acid) not to exceed 102.9 µg/L.
- (j) - Sum of 1,2,3-TMB, 1,2,4-TMB and 1,3,5-TMB isomers not exceed 23.2 µg/L for VHA.
- (k) - Uranium MCL is the Vermont MCL. Federal MCL is 30 µg/L.

TABLE 2 - Proposed List of VHAs with Potential Concern

Chemical Name	CAS No.	VHA (µg/L)	Use	Notes	VOC, SOC, IOC,	DW Lab Method	Method Detection Limit	Lab Cost
Acifluorfen, sodium	62476-59-9	4.5	Herbicide	Herbicide used for soybeans, rice, strawberries. Only 1 product registered in VT	SOC	515.2; USGS NWQL 0-1131-95; EPA OGWDW/TSC 515.3	0.250 µg/L; 0.008 µg/L; 0.470 µg/L	\$201-\$400
Anatoxin-a	64285-06-9	0.5	N/A	Surface water algae blooms	NA	545	0.5 µg/L	\$75
Anthracene	120-12-7	342.9	Poly Aromatic Hydrocarbon	coal tar and dyes	VOC	525.2	0.068 µg/L	\$201 - \$400
Benfenin (Benfluralin)	1861-40-1	5.5	Herbicide	Turf herbicide often used on golf courses and Right of way	SOC	ELISA; USGS-NWQL 0-1126-95	0.05 µg/L; 0.013 µg/L	
Benomyl	17804-35-2	9.5	Fungicide	Fungicide mainly used on rice and soybeans; obsolete as of 7/09/97	SOC	USGS-NWQL 0-2060-01	0.002 µg/L	<\$50; \$201-\$400
Bensulide	741-58-2	15.6	Herbicide	Herbicide for annual grasses and broadleaf weeds; used on golf courses, home lawns and ornamentals	SOC	CCL3	LOQ 1.0 µg/L	

Bentazon	25057-89-0	453.1	Herbicide	Broadleaf and sedge herbicide used in corn, beans, soybeans sorghum, and seed production of alfalfa and clover	SOC	515.2; TSC/NERL 515.1; EPA -OGWDW/TSC 515.3; USGS NWQL 0-1131-95; EPA -OGWDW/TSC 515.4	0.630 µg/L; 0.11 µg/L; 0.880 µg/L; 0.014 µg/L; 0.064 µg/L	\$201- \$400
Bis(2-chloro-1-methyl ethyl) ether	108-60-1	45.7	Insecticide	Insecticidal wood preservative. Solvent for fats, extractant, paint, and varnish removers, spotting agents and cleaning solutions. Never produced in the US as a pesticide.	SOC	EPA 611	0.3 µg/L	
Boron	7440-42-8	869.6	Insecticide, glass making; & cleaners, high energy fuel, fire retardant,	As Boric acid used in insect bait traps. Boron is a soil nutrient	SOC	USGS NWQL 1-1114; Method 305; Method 200.7; EPA-NERL 200.7; Standard Method 3120B; ASTM D1976; EPA-NERL 212.3	DCP-Aes range 10-1000 µg/L; 5.0 µg/L; 5.0 µg/L; 3.0 µg/L; 5 µg/L; 5 µg/L; 100 µg/L	
Bromacil	314-40-9	110.9	Herbicide	Broad spectrum herbicide in citrus and pineapple. Registered for use in industrial settings for weed control (power stations)	SOC	525.2; EPA-OGWDW/TSC 551.1; EPA 527; EPA-TSC/NERL 507; USGS-NWQL 0-1131-95	0.100 µg/L; 0.03 µg/L; 0.093 µg/L; 0.690 µg/L; 0.011 µg/L	\$201- \$400

Bromoxynil	1689-84-5	1	Herbicide	Used in selective contact herbicides for post-emergent control of broad-leaved weeds.	SOC	USGS-NWQL 0-1131-95; USGS 0-2060-01	0.012 µg/L; 0.009 µg/L	\$200-400
Butylate	2008-41-5	113.6	Herbicide	Herbicide; obsolete as of 7/14/10	SOC	525.2	0.064 µg/L	\$200-400
Carboxin	5234-68-4	22.3	Fungicide	Systemic fungicide; obsolete as of 2/14/19	SOC	525.2	1.4 µg/L	\$200-400
Chlorantraniliprole	500008-45-7	5208.6	Insecticide	Insecticide; registered uses: pome fruit, stone fruit, leafy vegetables, cucurbit vegetables, fruiting vegetables, cotton, grapes, potatoes, rice, ornamentals, turf grass growing in residential, commercial, and public landscaped areas.	SOC	EPA ECM	0.03 µg/L LOD; 0.10 µg/L LOQ	
Chlorpyrifos	2921-88-2	20	Insecticide	Insecticide; Vermont cancelled in 11/30/18	SOC	525.2	0.44 µg/L	\$200-400
Chlorothalonil	1897-45-6	1.6	Fungicide	Fungicide; turf, golf courses, lawns	SOC	525.2	0.120 µg/L	\$200-400

Cyanazine	21725-46-2	1	Herbicide	Herbicide, broad-spectrum in corn, sorghum, and wheat; obsolete as of 8/10/93	SOC	525.2	0.170 µg/L	\$200-400
Cylindrospermopsin	NA	0.5	N/A	Surface water algae bloom	NA	545	0.5 µg/L	\$25
Diazinon (Spectracide)	333-41-5	0.6	Insecticide	Insecticide primarily in cattle ear tags in Vermont. Limited ag uses for small commodity crops (e.g. beets and blackberries)	SOC	525.2	0.110 µg/L	\$200-400
Dichloroprop	120-36-5	140	Herbicide	Herbicide; obsolete as of 2/6/08	SOC	515.3	0.510 µg/L	\$200-400
Dioxane (1,4)	123-91-1	0.3	Solvent		VOC	522; EPA-EAD 1624	0.026 µg/L; 10 µg/L	>\$400
Diphenamid	957-51-7	200	Herbicide	Broad spectrum herbicide, vegetables, fruit trees, citrus trees, strawberries, and ornamental plants, trees and shrubs. Obsolete 9/11/91	SOC	525.2	0.041 µg/L	\$200-400
Disulfoton	298-04-4	0.3	Insecticide	Insecticide for mites, aphids, thrips, mealybugs, and other sucking insects. Obsolete as of 10/24/02	SOC	525.2; EPA-OGWDW/TSC 526	0.1 µg/L (0.62/1.3/0.18/0.11)--based on differing test methods; 0.020 µg/L	\$201 - \$400

Diuron	330-54-1	10	Herbicide	Broad-spectrum algaecide and broad-spectrum, systemic herbicide. The main applications are in paints, coatings and plasters.	SOC	EPA-OGWDW/TSC 532; Abraxis 520001; USGS-NWQL 0-2060-01	0.018 µg/L; 0.030µg/L; 0.0075 µg/L	\$201 - \$400
Fenamiphos	22224-92-6	2	Insecticide	Nematicide for field, vegetable, and fruit crops; obsolete as of 10/25/11	SOC	525.2	0.95/1.6/0.24/ 0.2 µg/L - based on differing test methods	\$201 - \$400
Fluoranthene	206-44-0	45.7	Coal tar, dyes		VOC	550.1	0.025 µg/L	
Fluorene	86-73-7	45.7	Dyes, pharmaceutical		VOC	525.2	0.059/0.11/0.25/0.054 µg/L - based on differing test methods	\$201 - \$400
Fonofos	944-22-9	10	Insecticide	Soil insecticide for corn; obsolete as of 11/03/98	SOC	EPA-OGWDW/TSC 526; USGS-NWQL 0-1126-95; USGS-NWQL 0-1402-01	0.020 µg/L; 0.008 µg/L; 0.008 µg/L	\$201 - \$400
Formaldehyde	50-00-0	1000	Wood, insulation		VOC	ASTM D6303-98/EPA Method 8315A (316)	6.2 µg/L	
Maneb	12427-38-2	35	Pesticide	Fungicide used as seed treatment in wide variety of field and vegetable crops; obsolete as of 9/15/09	SOC	EPA Method 630	15.3 µg/L	

Methyl parathion	298-00-0	2	Insecticide	Insecticide for agricultural pests; obsolete 12/2013	SOC	EPA Method 614	0.012 µg/L	\$201 - \$400
Microcystin	NA	0.16	N/A	Surface water algae bloom	NA	544	0.16 µg/L	\$25
Molybdenum	7439-98-7	5.7	metal		IOC	200.8	0.3 µg/L	
Octahydro-1,3,5,7-tetranitro-1,2,3,5,7-tetrazocine (HMX)	2691-41-0	57.1	Explosive & Detonator		VOC	529 EPA-NERL; 8330B EPA-RCA; 0-1124-94 USGS-NWQL	Detection Limit not provided for two EPA methods; for the USGS-NWQL 0.12 µg/L	
Paraquat dichloride	1910-42-5 & 4685-14-7 (TSCA)	30	Herbicide	Defoliant and desiccant herbicide to control weeds and grasses and as a harvest aid for many field, vegetable, and fruit crops. Extremely limited use in Vermont. not available to general public in the USA	SOC	549.2 EPA-NERL; MW A00147	0.68µg/L; 0.02µg/L	
Pentaerythritol tetranitrate (PETN)	65324 / 78-11-5	2.3	Explosive	Explosive and Vasodilator agent (treats angina pectoris)	VOC	529 EPA-NERL; 8330B EPA-RCA	no value given	
Perchlorate	1479-73-0	2.2	Fire works; Propellant, oxidizer; explosive		VOC	332 EPA-NERL; 314.1 EPA-OGWDW/TSC; 314 EPA-OGWDW/TSC; 331 EPA-TSC/NERL	0.020 µg/L; 0.030 µg/L; 0.530 µg/L; 0.005 µg/L	

			component of rocket fuel					
Propam (Prophos) - Isopropyl Phenylcarbamate	122-42-9	100	Herbicide	Herbicide for grasses & broadleaf weeds on forage crops, flax, lettuce, safflower, spinach, sugar beets, lentils & peas; obsolete 9/30/91	SOC	#4 NPS survey method; USGS-NWQL 0-2060-01; AOAC 992.14; NIOSH Manual of Analytical Methods 4th ed., Method 5601	0.75 µg/L; 0.0048 µg/L; detection limit not provided; 0.8 µg/L	
Propoxur (Baygon)	114-26-1	6.2	Insecticide	Insecticide used in bait stations to control ants and roaches (interior use); acaricide; flea control	SOC	531.2 EPA-OGWDW/TSC; AOAC 991.06; ASTM D5315; EPA-TSC/NERL 531.1; Standard Methods 6610B; OSW Method 8318-W; USGS-NWQL 0-2060-01; USGS-NWQL 0-1131-95; NIOSH Manual of Analytical Methods 4th ed., Method 5601	0.037 µg/L; 1.0 µg/L; 1 µg/L; 1 µg/L; 1.0 µg/L; 2.4 µg/L; 0.004 µg/L; 0.008 µg/L; 0.6 µg/L	
Triazole (1,2,4)	288-88-0	20	Pesticide & herbicide metabolite, Conductor, drug manufacturing product	Degradant of fungicide tebuconazole used on golf courses, field and vegetable crops; (anti fungal, sedatives, diuretic, anti inflammatory, anti bacterial, anti convulsant); photographic film	SOC	Environmental Chemistry Method (ECM) 49762553 (pesticide analytical method-water); ILV - 1,2,4-triazole in Water - MRID 50289802; USGS-NWQL 0-2060-01	0.05µg/L	

				paper, plat and chemical manufacturing				
Triazole metabolites (Conjugated: Triazole alanine & triazole acetic acid)	86362-20-1, 28711-29-7 and Triazolylpyruvic acid	102.9	Pesticide metabolite; pharmaceuticals, herbicide.	Degradant of fungicide tebuconazole used on golf courses, field and vegetable crops	SOC	NCBI-PubMed Sept. Oct. 2005 - LC/MS/MS	0.50 ppb in water (raw and tap)	
Trichlorophenoxyacetic acid (2,4,5) (2,4,5-T)	93-76-5	70	Herbicide; defoliant	Herbicide; obsolete as of 1/22/91; (no longer in use on food crops in US)	SOC	515.2; EPA 515; ASTM D5317; EPA-NERL 555; EPA-OGWDW/TSC 515.3; EPA-OGWDW/TSC 515.4; EPA-TSC/NERL 515.1; Modern Water A00212; USGS-NWQL 0-1131-95;	0.160 µg/L ; 0.01 µg/L; 0.080 µg/L; 1.300 µg/L; 0.200 µg/L; 0.024 µg/L; 0.045 µg/L; 1.400 µg/L; 0.010 µg/L	
Triclopyr	55335-06-3	165.3	Herbicide; forestry herbicide	Herbicide used for woody plants, vines and broadleaf weeds	SOC	USGS-NWQL 0-1131-95; USGS-NWQL 0-2060-01	0.010 µg/L; 0.011 µg/L	
Trimethyl benzene (1,2,3)	526-73-8	23.2	Fuel additive; solvent & used in dye and perfume manufacturing		VOC	USGS-NWQL 0-4127-96	0.036 µg/L	

Trinitrotoluene (2,4,6) (TNT)	118-96-7	0.8	Explosive & industrial applications		VOC	EPA 529; EPA SW-846 Method 8095 (GC); EPA-RCA 8330B; USGS-NWQL 0-1124-94	0.084 µg/L; ?; N/A; 0.110 µg/L	
Zineb	142-14-3 (12122-67-7)	350	Pesticide; fungicide-ag. use, paint, wood, crops, seeds, fabric, leather	Fungicide used on fruits, vegetables, field crops and a large number of ornamental plants and for treatment of many seeds. In paints and on fabrics, leather, linen, painted surfaces, surfaces to be painted and paper, plastics and wood surfaces. Obsolete as of 1997	SOC	EPA Method 630.1	4.1 µg/L	