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1.0ACKNOWLEDGEMENTS

This Drinking Water PFAS Response Plan guidance document has been prepared collaboratively under contract #39144 between the Drinking Water and Groundwater Protection Division and Weston & Sampson Engineers, Inc. The Drinking Water PFAS Response Plan (Plan) guidance document has been developed for the target audience of state regulators, professional consultants, and public water system personnel (owners and operator) who may use this Plan as a reference guide to plan, prepare for and implement response action if per- and poly-fluoroalkyl substances are detected in a public drinking water system. This Plan has been prepared in accordance with the requirements as outlined under the Vermont Water Supply Rule (WSR or Rule), Chapter 21, last revised April 12, 2019 and provides clarification to the requirements that are already within the scope of the rule provisions, and within the scope of statutory provision. **This Plan is not a substitute for the Rule and is for educational purposes only**.

2.0ACRONYMS

The following acronyms are utilized throughout this Drinking Water PFAS Response Plan guidance document.

AIX	Anion Ion Exchange Treatment
AFFF	Aqueous Film-Forming Foam
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing Methods
BOCA	Building Officials and Code Administration
CAP	Corrective Action Plan
CWS	Community Water System
CT	Concentration times Time
DND	Do Not Drink Public Notification
DWGWPD	Drinking Water and Groundwater Prevention Division
EBCT	Empty Bed Contact Time
ECAA	Environmental Cleanup Alternatives Analysis
ECF	Environmental Contingency Fund
EPA	Environmental Protection Agency of the United States
EPR	Environmental Protection Rule
GAC	Granular Activated Carbon
gpm	Gallons per minute
IX	Ion Exchange
IRULE	Investigation and Remediation of contaminated Properties Rule, July 6, 2019, Chapter 35 of Vermont Environmental Protection Rules
MCL	Maximum Contaminant Level
NIOSH	National Institute for Occupational Safety and Health
NOAV	Notice of Alleged Violation
NSF	National Sanitary Foundation
NTNC	Non-Transient Non-Community Water Supply
NTU	Nephelometric Turbidity Units
ng/L	Nanograms per Liter (or parts per trillion)
O&M	Operation & Maintenance
PFAS	Per and Polyfluorinated Alkyl Substances
PFHpA	Perfluoroheptanoic Acid
PFHxS	Perfluorohexane Sulfonic Acid
PFNA	Perfluorononanoic Acid
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctane Sulfonic Acid
PE	Professional Engineer (Vermont licensed familiar with WSR)
PSI	Pounds per Square Inch
ppt	Parts per Trillion
PRV	Pressure Reducing Valve
PSOC	Potential Sources of Contamination
PVC	Polyvinyl Chloride
PWS	Public Water System – Community, Non-Transient Non-Community or Transient Non-Community

Regulated PFAS	Vermont Act 21 Regulated PFAS (perfluorooctanoic acid, perfluorooctane sulfonic acid, perfluorohexane sulfonic acid, perfluorononanoic acid, perfluoroheptanoic acid)
RO	Reverse Osmosis
RP	Responsible Party
SOP	Standard Operating Procedure
SPA	Source Protection Area
SPP	Source Protection Plan
TDS	Total Dissolved Solids
TNC	Transient Non-Community Water Supply
TOC	Total Organic Carbon
TSS	Total Suspended Solids
UV	Ultraviolet
VTDEC	Vermont Department of Environmental Conservation
VTDOH	Vermont Department of Health
V.S.A.	Vermont Statute Annotated
WID	Water Infrastructure Division
WMPD	Waste Management and Prevention Division
WSR	Water Supply Rule, Chapter 21 State of Vermont Environmental Protection Rules

3.0INTRODUCTION AND BACKGROUND

Per- and polyfluoroalkyl substances (PFAS) are a group of man-made chemicals that includes PFOA, PFOS, PFHxS, PFHpA, PFNA, GenX, and thousands of other chemicals. PFAS have been manufactured and used in a variety of industries around the globe, including in the United States since the 1940s. PFOA and PFOS have been the most extensively produced and studied of these chemicals. PFAS are very persistent in the environment and in the human body – meaning they don't break down and they can accumulate over time.

PFAS can be found in:

- Food packaged in PFAS-containing materials, processed with equipment that used PFAS, or grown in PFAS-contaminated soil or water.
- Commercial household products, including stain- and water-repellent fabrics, nonstick products (e.g., Teflon), polishes, waxes, paints, cleaning products, and fire-fighting foams (a major source of groundwater contamination at airports and military bases where firefighting training occurs).
- Workplace, including production facilities or industries (e.g., chrome plating, electronics manufacturing or oil recovery) that use PFAS.
- Drinking water, typically localized and associated with a specific facility (e.g., manufacturer, landfill, wastewater treatment plant, firefighter training facility).
- Living organisms, including fish, animals and humans, where PFAS have the ability to build up and persist over time.

PFOA and PFOS are no longer manufactured in the United States as a result of phase outs including the PFOA Stewardship Program in which eight major chemical manufacturers agreed to eliminate the use of PFOA and PFOA-related chemicals in their products and as emissions from their facilities. Although PFOA and PFOS are no longer manufactured in the United States, they are still produced internationally and can be imported into the United States in consumer goods such as carpet, leather and apparel, textiles, paper and packaging, coatings, rubber and plastics.

Most people have been exposed to PFAS. Certain PFAS can accumulate and stay in the human body for long periods of time. There is evidence that exposure to PFAS can lead to adverse health outcomes in humans. The most-studied PFAS compounds are PFOA and PFOS. Studies indicate that PFOA and PFOS can cause reproductive and developmental, liver and kidney, and immunological effects in laboratory animals. Both chemicals have caused tumors in animals. Some scientific studies suggest that certain PFAS may affect different systems in the body. Although more research is needed, some studies in people have shown that certain PFAS may:

- Affect growth, learning and behavior of babies and older children
- Lower a woman's chance of getting pregnant
- Interfere with the body's natural hormones
- Increase cholesterol levels
- Affect the immune system
- Increase the risk of cancer

There are a variety of ways that people can be exposed to these chemicals and at different levels of exposure. For example, people can be exposed to low levels of PFAS through food, which can become contaminated through:

- Contaminated soil and water used to grow the food,
- Food packaging containing PFAS, and
- Equipment that used PFAS during food processing.

People can also be exposed to PFAS if they are released during normal use, biodegradation, or disposal of consumer products that contain PFAS. People may be exposed to PFAS used in commercially treated products to make them stain- and water-repellent or nonstick. These goods include carpets, leather and apparel, textiles, paper and packaging materials, and non-stick cookware.

People who work at PFAS production facilities, or facilities that manufacture goods made with PFAS, may be exposed in certain occupational settings or through contaminated air.

Drinking water can be a source of exposure in communities where these chemicals have contaminated water supplies. PFAS have been found in a number of drinking water supplies throughout New England and Vermont. Large public water supplies in Portsmouth, NH and Devens, MA have been contaminated with PFAS from use and releases of aqueous film forming foams (AFFF) used in firefighting. In Vermont, PFAS have been found in hundreds of private water supplies in the Bennington area and in private well supplies near wire-coating facilities as a result of industrial use of PFAS. A public water supply in Pownal has also been identified as having PFAS above current health advisory and Vermont Interim Standard levels resulting from industrial discharges. PFAS contamination has also been found at a business park near the Rutland regional airport due to AFFF used following a plane crash.

The presence of PFAS in the water supplies have resulted in significant response efforts to identify PFAS sources, and design and installation of treatment systems to eliminate exposure of the public to contaminated drinking water. The response actions undertaken have been complex, time consuming and costly.

On May 15, 2019, the State of Vermont passed Act 21, which mandated monitoring of PFAS at public water supplies. It also mandated a Do Not Drink public notice be issued if exceedance of a interim drinking water standard of 20 parts per trillion (ppt) was exceeded. As a result, the Drinking Water and Groundwater Prevention Division (DWGWPD) and the Waste Management and Prevention Division (WMPD) are providing this educational guidance document for public water systems to respond to detections or standard exceedance of PFAS in their water system. Act 21 is included in **Attachment 1**. This Response Plan applies to all Public Water Systems (PWS): public Transient Non-Community Water Systems (TNCWS), public Non-Transient Non-Community Water Systems (NTNCWS) and Community Water Systems (CWS), though only Public Community and Public NTNC water systems have been mandated to monitor their supply sources by December 1, 2019.

The Vermont Department of Health has issued a health advisory of 20 nanograms-per-liter (ng/L), also known as parts-per-trillion (ppt), for the following five (5) PFAS compounds:

https://www.healthvermont.gov/sites/default/files/documents/pdf/ENV_DW_PFAS.pdf

Table 1. Five Vermont Regulated PFAS Compounds

Name	PFAS compound	Formula	mass (g/mol)
PFOA	perfluorooctanoic acid	$C_8HF_{15}O_2$	414.07
PFOS	perfluorooctane sulfonic acid	$C_8HF_{17}O_3S$	500.13

PFHxS	perfluorohexane sulfonic acid	$C_6HF_{13}O_3S$	400.12
PFNA	perfluorononanoic acid	$C_9HF_{17}O_2$	464.08
PFHpA	perfluoroheptanoic acid	$C_7HF_{13}O_2$	364.06

The Vermont Department of Environmental Conservation (VTDEC) has implemented an interim drinking water standard of 20 ng/L combined for the five regulated PFAS above. During the summer and fall of 2019 (Prior to December 1, 2019), nearly 600 CWSs and NTNCs are required to collect water samples from every entry point to the distribution pipe network for analysis of regulated PFAS. All sampling data will be submitted to the DWGWPD.

If regulated PFAS compounds are detected in these samples, DWGWPD will require the PWS to complete actions as shown in Table 2. If results from sampling (and/or confirmatory sampling) activities indicate that the sum of regulated PFAS compounds exceed 20 nanograms per liter (ng/L), the DWGWPD will issue a Notice of Alleged Violation (NOAV). A representative NOAV is included in **Appendix A**. The NOAV will instruct the PWS to issue public notice of the results, and to issue a 'Do Not Drink' Notice to the water system's users. The NOAV will also direct the PWS to take action to ensure that water provided to the PWS users consistently and reliably meets state and federal water quality standards. The PWS will be required to provide the DWGWPD with a plan and schedule to consistently and reliably meet state and federal water quality standards.

Table 2. Summary of Sampling Results and Actions under Act 21

Initial Sampling Result	Confirmatory Sampling Required	Mean Sampling Concentration	Notifications to Users	Monitoring Schedule	Next Steps
< 2.0 ng/L	No	N/A	N/A	Every 3 years	Monitor
≥2.0 ng/L <20 ng/L	No	N/A	CWS notify users through the Consumer Confidence Report (CCR)	Annual	Monitor & Initiate Planning for Potential Response Actions
20 ng/L	No	N/A	CWS notify users through the Consumer Confidence Report (CCR) NTNCs need to provide direct notice as directed by Division	Quarterly	Monitor & Initiate Planning for Potential Response Actions
>20 ng/L ≤40 ng/L	Yes	≤20	Public notice informing of results and provide resources	Quarterly	Monitor & Initiate Planning for Potential Response Actions
	Yes	>20	"Do Not Drink" notice within 24hrs of sampling results from confirmation sample	TBD	Emergency Response Action
> 40 ng/L	Yes	N/A	"Do Not Drink" notice within 24hrs of results from initial sample	TBD	Emergency Response Action

N/A – not applicable, TBD – to be determined and may be adjusted by DWGWPD

When a PWS initially reports the sum of regulated PFAS concentrations greater than 20 ng/L, the DWGWPD and the Waste Management Protection Division (WMPD) are the primary divisions within VTDEC involved with the characterization, mitigation, and clean-up activities of PFAS at the public water system/managed site. The WMPD has additional requirements regarding assessment of PFAS source(s), Responsible Parties (RPs) and remediation in addition to those required by the DWGWPD.

This Plan has been developed for the target audience of state regulators, professional consultants, and PWS personnel (owners and operators) who may use this Plan as a reference guide to plan and implement response actions for the presence of PFAS within Public Water Systems. The Plan provides information about the actions to be completed by a PWS in response to PFAS presence, including a description of response alternatives that a PWS may consider in accordance with the Vermont Water Supply Rule, Chapter 21 of the State of Vermont Environmental Protection Rules (WSR) for immediate (emergency), short-term, and long-term actions to provide the PWS users water that meets all state public drinking water standards when the interim standard is exceeded.

The Plan has been prepared in accordance with V.S.A. Environmental Protection Rules (EPR), Chapter 21 - Water Supply Rule, approved April 12, 2019 and the requirements of Act 21 of 2019. The PWS is to consult with the DWGWPD prior to taking any response action to ensure such actions would comply with the WSR and Act 21.

A key element of this Plan is the response action decision tree created to assist the PWS and its professional engineer to plan for and implement response actions, including an alternatives analysis in accordance with the WSR. The response action decision tree is augmented by the text sections of this Plan and must be utilized in conjunction with the WSR, April 12, 2019. **No actions can be performed by the PWS without consulting with the DWGWPD.**

Close coordination and communication with DWGWPD is important to ensure that the response actions taken by the PWS are conducted in accordance with the requirements of the WSR. In order to perform an alternatives analysis and implement response actions, the PWS will need to contract with a Vermont licensed professional engineer to ensure the response actions meet the permitting, construction and technical standards within Appendix A of the WSR. It is understood that to expeditiously allow for emergency, short and long-term responses that various provisions of the WSR be can applied, including:

Subchapter 21-3: Permits - Administration

- *21-3.0.3: No person shall use or connect an unpermitted water source, including an emergency source, to a Public Water System, except*
    - *(a) following public notice to the water system customers (according to Agency public notification requirements);*
    - *(b) providing notice to the Secretary as soon as possible, but no later than within 12 hours of its connection or use; and*
    - *(c) in an emergency situation for a limited duration, no more than 90 cumulative days without prior written approval of extension by the Secretary.*
- *21-3.7: Variances from Technical Standards*

Subchapter 21-4: Source and Construction Permits

- *21-4.0.2: Exemptions from Source and Construction Permits - No Construction Permit for Public water systems will be required for minor system improvements such as replacement of hydrants on existing distribution line(s), pipe extension projects of less than 500 feet, minor alterations or maintenance of an existing water system, and* ***no source permit will be required for minor maintenance such as replacement of source pump or source structure repair****, which would not in and of itself adversely affect the quality or quantity of water service rendered, providing work is done according to the Vermont Standards for Water System Design, Construction and Protection (see Appendix A of this rule). It is recommended that the water supplier contact the Secretary for consultation on plans for minor improvements.* **(emphasis added).**

Subchapter 21-5: Operating Permits

- *21-5.3.3: A Public water system operating permit shall only be issued or renewed upon a finding by the Secretary, included in the permit that operation of the system will comply with this Rule and will not constitute a public health hazard or significant public health risk. Such finding shall be based on a review of the application and* *other applicable information. The Secretary may exempt Public water systems, or portions of those systems, which were in existence prior to September 24, 1992, and which do not pose a significant public health risk, from Appendix A requirements.*

Appendix A, Part 12.2 Construction Standards for Monitoring Wells, Public Non-Transient Non-Community water systems and Public Transient Non-Community water systems

- *Part 12.2.2.2: The well driller shall perform the following, unless the Department grants an exemption:*

  (a) *Bedrock Wells*
  All bedrock wells shall be constructed with not fewer than 20 feet of water tight casing. The casing shall be securely set into competent bedrock. The casing shall prevent sediment or fluids from above the bottom of the casing from entering the well.

  (b) *Gravel Wells*
  All gravel wells shall be constructed with not less than 20 feet of water tight casing.

  (c) *Lining Wells*
  When a liner is set to control hole stability within the uncased hole it shall be terminated with a packer or otherwise secured to the bore hole. It may be slotted, screened or perforated to permit the movement or storage of water. When a liner is set to control water movement or contamination, it shall be adequately grouted and water tight.

Appendix A, Part 12.3 Construction and Isolation Standards for Wells Requiring Permits

- *Part 12.3.8.1 Drilled wells shall provide watertight construction to such depths as may be required by the Secretary, to:*

  (a) *exclude surface contamination, and*
  (b) *seal off formations that are contaminated or yield undesirable water.*

- *Part 12.3.8.2 Drilled bedrock wells shall have casing installed a minimum of 10 feet into unweathered competent bedrock. A minimum of 20 feet of casing shall be installed in all bedrock wells.*

- *Part 12.3.14.1 All permanent well casing, including the couplings, (except driven Schedule 40 steel casing with the approval of the Secretary), shall be surrounded by a minimum of 1½ inches of grout to the required depth. All temporary construction casings should be removed, but shall be withdrawn at least ten feet to insure grout contact with the native formation.*

  Deviation from the grouting standards contained herein may be allowed after review under the provisions of Section 3.7 in Subchapter 21-3.

Please note:

- Prior to April 12, 2019, supply sources to serve NTNC water systems were not required to be grouted, standards were similar to standards for homeowner wells.
- Prior to September 24, 1992, technical standards did not require wells constructed as CWS supply sources to be grouted.
- Based on this history, it would be very uncommon for a NTNC well to be grouted and it would not be uncommon for a PCWS well constructed prior to 9/24/1992 to be ungrouted.

- *Section 11.2.1 General Requirements*
  *Bulk water is potable water for human consumption delivered to the consumer or a **Public** water system by means other than a pipeline or bottled water. It is typically delivered by tanker truck or trailer. Bulk water delivery is usually limited to emergency or temporary situations except for those bulk water operations permitted by the Secretary to be used as a source for **Bottled** water systems. If water loading stations are used to fill bulk water tankers, the loading station shall comply with the requirements of Appendix A, Subpart 8.11, Water Loading Stations.*

- *Section 11.2.2 Source Requirements and Water Quality Standards*

  No person shall distribute, transport, or provide bulk water for human consumption or other consumer uses unless:
  - *(a) the water is supplied from either a permitted **Public Community** water system or a Bottled water system permitted by the Secretary;*
  - *(b) the water system in Subsection 11.2.2(a) meets the applicable requirements of Subchapter 21-6;*
    the bulk water contains a free chlorine residual between 1.0 ppm and 4.0 ppm, or the bulk water supplier meets the requirements as specified under Subsection 11.2.3; and
  - *(c) other requirements that may be imposed by the Secretary to protect public health and welfare are met.*

- *Section 11.2.3 Tanker Requirements for Hauling Water*

  - *(a) No person shall provide bulk water for human consumption unless the water tanker, water hoses, valves, and other surfaces coming into contact with the water are constructed of smooth, nonabsorbent, corrosion-resistant, and non-toxic material safe for contact with potable water.*
  - *(b) A bulk water hauler shall develop and implement a Standard Operating Procedure (SOP) to ensure and document the sanitary conditions of the bulk water hauling operation for each delivery. This SOP shall outline the frequency and method of the vehicle tank cleaning, Total Coliform Bacteria testing, and Heterotrophic Plate Count (HPC) testing. If the HPC count is greater than or equal to 500 colony-forming units per 1 ml, the bulk water hauler shall investigate and correct the source of contamination. The SOP shall be available to the Secretary upon request.*
  - *(c) All bulk water transportation vehicles shall be dedicated to the sole purpose of transporting drinking water as defined by 10 VSA, Section 1671 and shall meet all the applicable requirements of this rule, including the Appendices (e.g., Filing Station requirements in Appendix A Subpart 8.11 and Finished Water Storage in Appendix A Subpart 7).*

Examples of applications of these WSR Provisions include:

A. **Source Structure Repairs:** A plausible mechanism for a PWS to become contaminated is transport of Regulated PFAS present in an unconsolidated aquifer into a bedrock PWS supply source through a poorly-constructed (ungrouted or poorly grouted casing) seal at the well's interface between the overburden and bedrock (ex: ungrouted or poorly grouted casing). In this example, pursuant to 21-4, 4.0.2 of the WSR, *source structure repairs* could be performed by installing a Jaswell Seal and grout, or by constructing a nearby *replacement well* with proper grouting and construction (Appendix App A, Part 12 of WSR), without first obtaining a Source Permit to complete this work. See **Sections 5.8** and **5.9** of this document for further description of these alternatives. A source permit may be required for a replacement well based on the location and construction of the replacement well.

B. **Bulk Hauling:** A PWS contaminated with Regulated PFAS may establish agreements with a bulk water hauler and a PWS (of equal or greater classification) to receive routine deliveries of bulk water. If the bulk water deliveries are performed in accordance with WSR Subchapter 21-11 and **Section 5.5** of this Plan, the PWS may be able to lift the Do Not Drink notice once this alternative is implemented.

C. **Use of Unpermitted Supply Source**: Pursuant to WSR Subchapter 21-3, an unpermitted supply source may be utilized in emergency situations when DWGWPD provides written authorization, such as an approval letter. For example, a PWS may elect to perform water quality testing and utilize an existing, unpermitted source of water (such as an emergency source) to supply the water system. Per WSR Subchapter 21-3, DWGWPD could provide written authorization to allow this unpermitted source to be utilized while alternatives for a long-term solution are evaluated. If the conditions of the DGWPD's written authorization are followed, which will likely include water quality testing and evaluation of the unpermitted source (pursuant to WSR Subchapter 21-6 and Act 21), then the PWS may be able to utilize the unpermitted source and lift the Do Not Drink notice. Similarly, these provisions may be utilized to construct a new supply source in a location remote from the PWS's existing source protection area, and to place this new source into operation to supply water to the PWS before the Source Permitting Process is completed.

4.0RESPONSE ACTION PROCESS

The response action process described below is designed to allow for a timely response to detected PFAS in a PWS through collaboration between the PWS, the DWGWPD, Waste Management and Prevention Division (WMPD), Water Infrastructure Division (WID), Vermont Department of Health (VTDOH), professional engineer, operator and water system users. Close communication and collaboration will be essential to assure the response actions undertaken are in compliance with the WSR, the Vermont State Plumbing Code of Regulations and follow best engineering practices.

Upon a PWS receiving a NOAV from the DWGWPD, the PWS will be directed to conduct a number of activities in a timely manner. Some key elements to be required by VTDEC include:

- Provide public notice to all PWS users, informing them that the water contains concentrations of regulated PFAS that exceed interim State drinking water standards. This notice shall also contain information directing users to sources of drinking water that is known to meet standards (bottled water vendors). The DWGWPD website link to a list of bottled water suppliers that have completed PFAS sampling can be found at:

  https://dec.vermont.gov/water/drinking-water/public-drinking-water-systems/imported-bottled-water-non-vt-water-sources
- Engage the services of a professional engineer experienced with the Vermont WSR.
- Perform and **Alternatives Analysis** following or concurrent with the emergency response and develop a longer-term solution. Required elements of an **Alternatives Analysis Report** are described in **Section 4.3.1**.
- Provide the DWGWPD with a proposed schedule and proposed actions to be taken in response to the regulated PFAS detections, including proposed emergency, short-term, and long-term actions (see **Section 4.0**).
- The PWS response actions must be pre-approved by the DWGWPD and comply with the requirements of the WSR.
- The DWGWPD will direct the system to **potentially available funding mechanisms**. These are described in **Section 7.0** of this Plan.

A template for a Do Not Drink Notice can be found at:
https://dec.vermont.gov/sites/dec/files/dwgwp/wqmonitoring/pdf/PFAS-PN-DND-Special-Notice.pdf
The "Do Not Drink" notice provided to the PWS users will specify:

- do not drink the water
- methods and locations to obtain potable water
- the sampling results
- links to relevant further information and where sampling results can be found

It is advised that the PWS review their insurance policies and contact insurance providers to inform them of the regulated PFAS contamination of the Water System and to inquire about the insurance provider's claims process. This insurance claim could provide a funding source for PWS responses while the WMPD performs its site evaluations to identify a RP. It is essential that the PWS consult with WMPD regarding integration of insurance claim(s) with WMPD requirements.
The WMPD will be notified of the PWS sampling results. The WMPD will evaluate the PFAS presence in accordance with EPR Chapter 35 Investigation and Remediation of Contaminated Properties Rule, July 6, 2019.

The WMPD will initiate an evaluation to determine, if possible, the source of the PFAS and identify the RP. The WMPD has the authority to direct a RP to provide an alternative source of potable water to PWS users. The WMPD may also require the RP to provide funding for water treatment at locations where a release of hazardous materials has resulted in contamination of a drinking water supply at concentrations above the Vermont regulated PFAS interim drinking water standard of 20 ng/L.

The response action process is generally comprised of 3 activities:

- *Emergency Response*: Immediate activities necessary to notify users and instruct users not to drink the water provided by the PWS.
- *Short-Term Response*: Interim measures to be utilized to provide safe drinking water to the system's users until such time as an approvable long-term response can be implemented. The Short-Term Response actions may serve as an interim solution while a long-term response is developed and/or may become the ultimate long-term response.
- *Long-Term Response*: This is a fully engineered and approved solution meeting the WSR.

It is anticipated that emergency and short-term responses will utilize Subchapters 21-3, 21-4, 21-5, 21-11and Appendix A (e.g. Parts 2, 3, 12.3, and 12.4) of the WSR in order to ensure a timely and permittable response to protect the health of drinking water users in response to the presence of PFAS contaminated drinking water.

4.1 Response Process, Decision Tree, and General Timeline

The Response Action Decision Tree shown on the following page (Figure 1) provides an overview of the *typical* response action process. The decision tree provides references to the actions required by Act 21 and the WSR. All response actions must consider the requirements of each of these documents. The decision tree provides a guide to support compliance with the requirements but does not include all of the detailed analyses necessary to fully assess potential response actions for each unique PWS. Consultation/communication with DWGWPD and a professional engineer familiar with the WSR and PWS design is essential to ensure a rapid and appropriate response to the presence of regulated PFAS in a PWS.

The Conceptual Response Timeline (Figure 2), identifies significant tasks and typical implementation schedules for conducting a response to the presence of regulated PFAS compounds in a PWS. This timeline is a general estimate of typical implementation times for each process and alternative presented in the figure and should be considered only a general guideline. System-specific information must be considered and utilized to develop an actual timeline and response schedule for any PWS with PFAS contamination.

The Conceptual Short/Long Term Alternative Implementation Milestones (Figure 3) provides estimated milestone tasks and implementation times for short-term and long-term response action alternatives described in Section 5 of this Report. These general timelines are intended to provide general information about the timelines for different alternative actions that may be considered by a PWS or its professional engineer. System-specific information must be considered and utilized to develop an actual timeline and response schedule for any PWS with PFAS

There are three (3) steps to the response plan which should be followed to comply with the regulatory requirements (Emergency Response, Short-Term Response and Long-Term Response). The generalized response steps are summarized below and discussed in more detail in the Decision Tree and following sections.

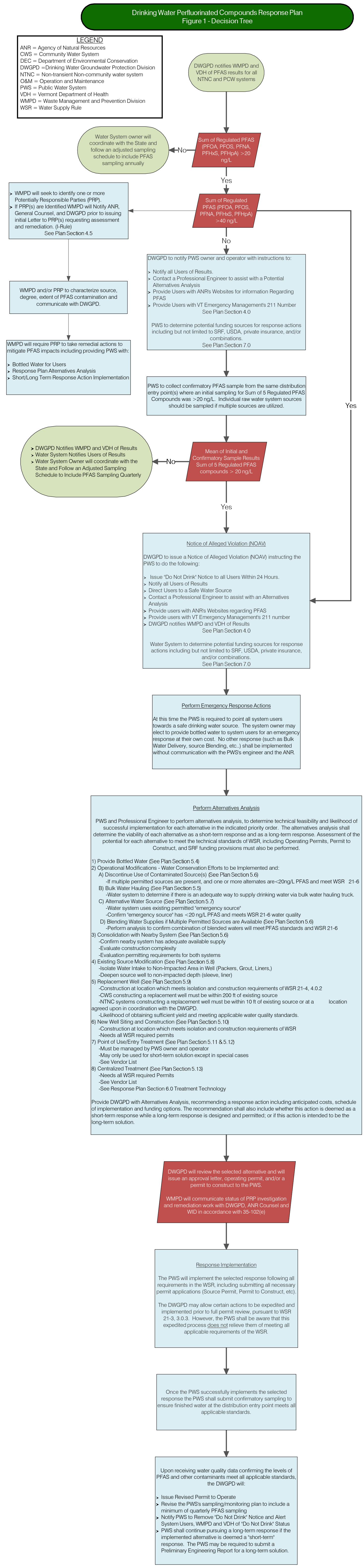

Drinking Water Perfluorinated Compounds Response Plan
Figure 1 - Decision Tree
LEGEND
ANR = Agency of Natural Resources
CWS = Community Water System
DEC = Department of Environmental Conservation
DWGPD =Drinking Water Groundwater Protection Division
NTNC = Non-transient Non-community water system
O&M = Operation and Maintenance
PWS = Public Water System
VDH = Vermont Department of Health
WMPD = Waste Management and Prevention Division
WSR = Water Supply Rule
DWGPD notifies WMPD and VDH of PFAS results for all NTNC and PCW systems
Sum of Regulated PFAS (PFOA, PFOS, PFNA, PFHxS, PFHpA) >20 ng/L
No
Water System owner will coordinate with the State and follow an adjusted sampling schedule to include PFAS sampling annually
Yes
Sum of Regulated PFAS (PFOA, PFOS, PFNA, PFHxS, PFHpA) >40 ng/L
WMPD will seek to identify one or more Potentially Responsible Parties (PRP).
If PRP(s) are Identified WMPD will Notify ANR, General Counsel, and DWGPD prior to issuing initial Letter to PRP(s) requesting assessment and remediation. (I-Rule)
See Plan Section 4.5
WMPD and/or PRP to characterize source, degree, extent of PFAS contamination and communicate with DWGPD.
WMPD will require PRP to take remedial actions to mitigate PFAS impacts including providing PWS with:
Bottled Water for Users
Response Plan Alternatives Analysis
Short/Long Term Response Action Implementation
No
DWGPD to notify PWS owner and operator with instructions to:
Notify all Users of Results.
Contact a Professional Engineer to assist with a Potential Alternatives Analysis
Provide Users with ANR's Websites for information Regarding PFAS
Provide Users with VT Emergency Management's 211 Number
See Plan Section 4.0
PWS to determine potential funding sources for response actions including but not limited to SRF, USDA, private insurance, and/or combinations.
See Plan Section 7.0
PWS to collect confirmatory PFAS sample from the same distribution entry point(s) where an initial sampling for Sum of 5 Regulated PFAS Compounds was >20 ng/L. Individual raw water system sources should be sampled if multiple sources are utilized.
Mean of Initial and Confirmatory Sample Results Sum of 5 Regulated PFAS compounds > 20 ng/L
No
DWGPD Notifies WMPD and VDH of Results
Water System Notifies Users of Results
Water System Owner will coordinate with the State and Follow an Adjusted Sampling Schedule to Include PFAS Sampling Quarterly
Yes
Yes
Notice of Alleged Violation (NOAV)
DWGPD to issue a Notice of Alleged Violation (NOAV) instructing the PWS to do the following:
Issue "Do Not Drink" Notice to all Users Within 24 Hours.
Notify all Users of Results
Direct Users to a Safe Water Source
Contact a Professional Engineer to assist with an Alternatives Analysis
Provide users with ANR's Websites regarding PFAS
Provide users with VT Emergency Management's 211 number
DWGPD notifies WMPD and VDH of Results
See Plan Section 4.0
Water System to determine potential funding sources for response actions including but not limited to SRF, USDA, private insurance, and/or combinations.
See Plan Section 7.0
Perform Emergency Response Actions
At this time the PWS is required to point all system users towards a safe drinking water source. The system owner may elect to provide bottled water to system users for an emergency response at their own cost. No other response (such as Bulk Water Delivery, source Blending, etc..) shall be implemented without communication with the PWS's engineer and the ANR.
Perform Alternatives Analysis
PWS and Professional Engineer to perform alternatives analysis, to determine technical feasibility and likelihood of successful implementation for each alternative in the indicated priority order. The alternatives analysis shall determine the viability of each alternative as a short-term response and as a long-term response. Assessment of the potential for each alternative to meet the technical standards of WSR, including Operating Permits, Permit to Construct, and SRF funding provisions must also be performed.
1) Provide Bottled Water (See Plan Section 5.4)
2) Operational Modifications - Water Conservation Efforts to be Implemented and:
A) Discontinue Use of Contaminated Source(s) (See Plan Section 5.6)
-If multiple permitted sources are present, and one or more alternates are<20ng/L PFAS and meet WSR 21-6
B) Bulk Water Hauling (See Plan Section 5.5)
-Water system to determine if there is an adequate way to supply drinking water via bulk water hauling truck.
C) Alternative Water Source (See Plan Section 5.7)
-Water system uses existing permitted "emergency source"
-Confirm "emergency source" has <20 ng/L PFAS and meets WSR 21-6 water quality
D) Blending Water Supplies if Multiple Permitted Sources are Available (See Plan Section 5.6)
-Perform analysis to confirm combination of blended waters will meet PFAS standards and WSR 21-6
3) Consolidation with Nearby System (See Plan Section 5.6)
-Confirm nearby system has adequate available supply
-Evaluate construction complexity
-Evaluation permitting requirements for both systems
4) Existing Source Modification (See Plan Section 5.8)
-Isolate Water Intake to Non-Impacted Area in Well (Packers, Grout, Liners,)
-Deepen source well to non-impacted depth (sleeve, liner)
5) Replacement Well (See Plan Section 5.9)
-Construction at location which meets isolation and construction requirements of WSR 21-4, 4.0.2
-CWS constructing a replacement well must be within 200 ft of existing source
-NTNC systems constructing a replacement well must be within 10 ft of existing source or at a location agreed upon in coordination with the DWGPD.
-Likelihood of obtaining sufficient yield and meeting applicable water quality standards.
6) New Well Siting and Construction (See Plan Section 5.10)
-Construction at location which meets isolation and construction requirements of WSR
-Needs all WSR required permits
7) Point of Use/Entry Treatment (See Plan Section 5.11 & 5.12)
-Must be managed by PWS owner and operator
-May only be used for short-term solution except in special cases
-See Vendor List
8) Centralized Treatment (See Plan Section 5.13)
-Needs all WSR required Permits
-See Vendor List
-See Response Plan Section 6.0 Treatment Technology
Provide DWGPD with Alternatives Analysis, recommending a response action including anticipated costs, schedule of implementation and funding options. The recommendation shall also include whether this action is deemed as a short-term response while a long-term response is designed and permitted; or if this action is intended to be the long-term solution.
DWGPD will review the selected alternative and will issue an approval letter, operating permit, and/or a permit to construct to the PWS.
WMPD will communicate status of PRP investigation and remediation work with DWGPD, ANR Counsel and WID in accordance with 35-102(e)
Response Implementation
The PWS will implement the selected response following all requirements in the WSR, including submitting all necessary permit applications (Source Permit, Permit to Construct, etc).
The DWGPD may allow certain actions to be expedited and implemented prior to full permit review, pursuant to WSR 21-3, 3.0.3. However, the PWS shall be aware that this expedited process does not relieve them of meeting all applicable requirements of the WSR.
Once the PWS successfully implements the selected response the PWS shall submit confirmatory sampling to ensure finished water at the distribution entry point meets all applicable standards.
Upon receiving water quality data confirming the levels of PFAS and other contaminants meet all applicable standards, the DWGPD will:
Issue Revised Permit to Operate
Revise the PWS's sampling/monitoring plan to include a minimum of quarterly PFAS sampling
Notify PWS to Remove "Do Not Drink" Notice and Alert System Users, WMPD and VDH of "Do Not Drink" Status
PWS shall continue pursuing a long-term response if the implemented alternative is deemed a "short-term" response. The PWS may be required to submit a Preliminary Engineering Report for a long-term solution.

Figure 2
PFAS Response Plan
Conceptual Response Timeline

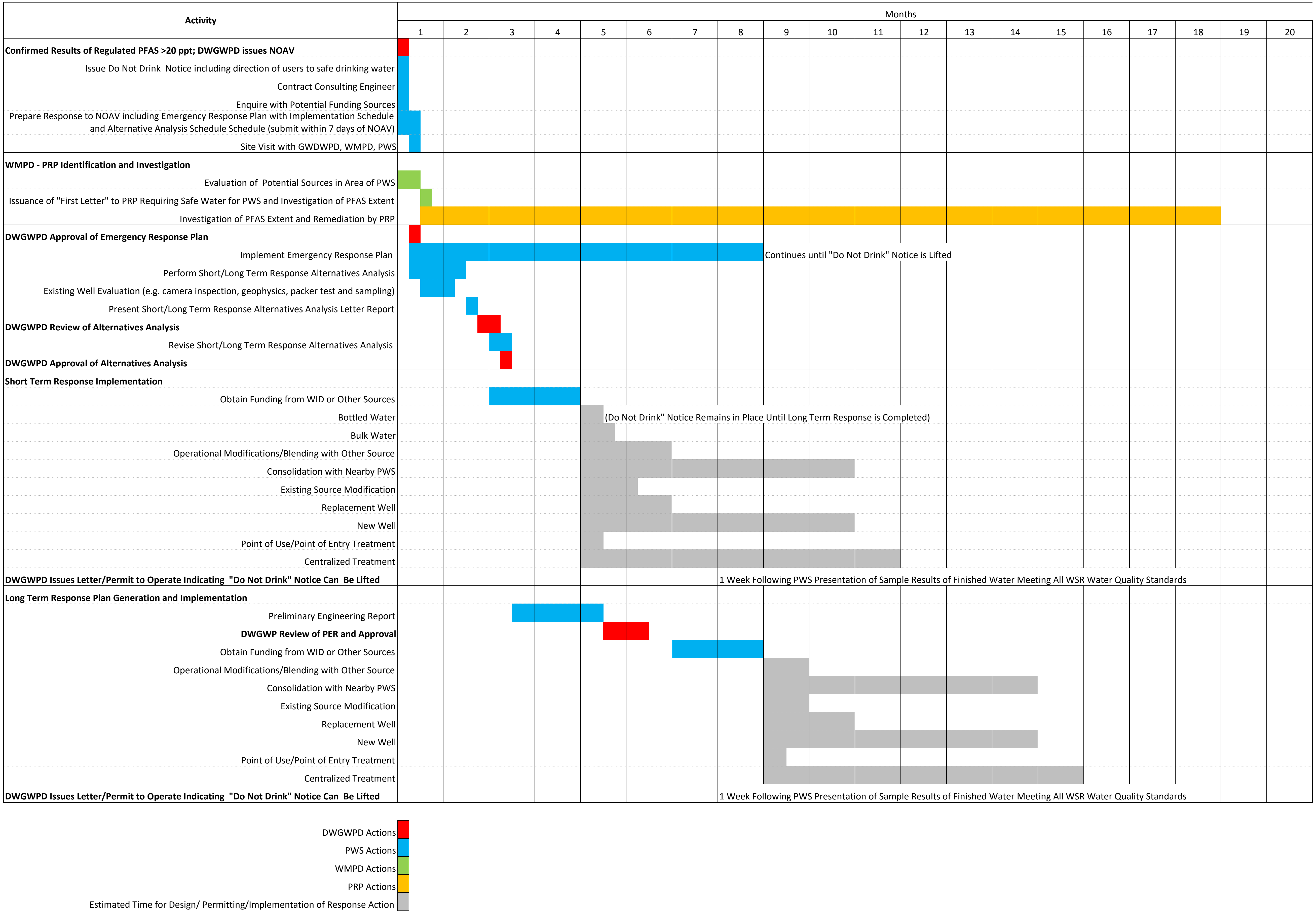
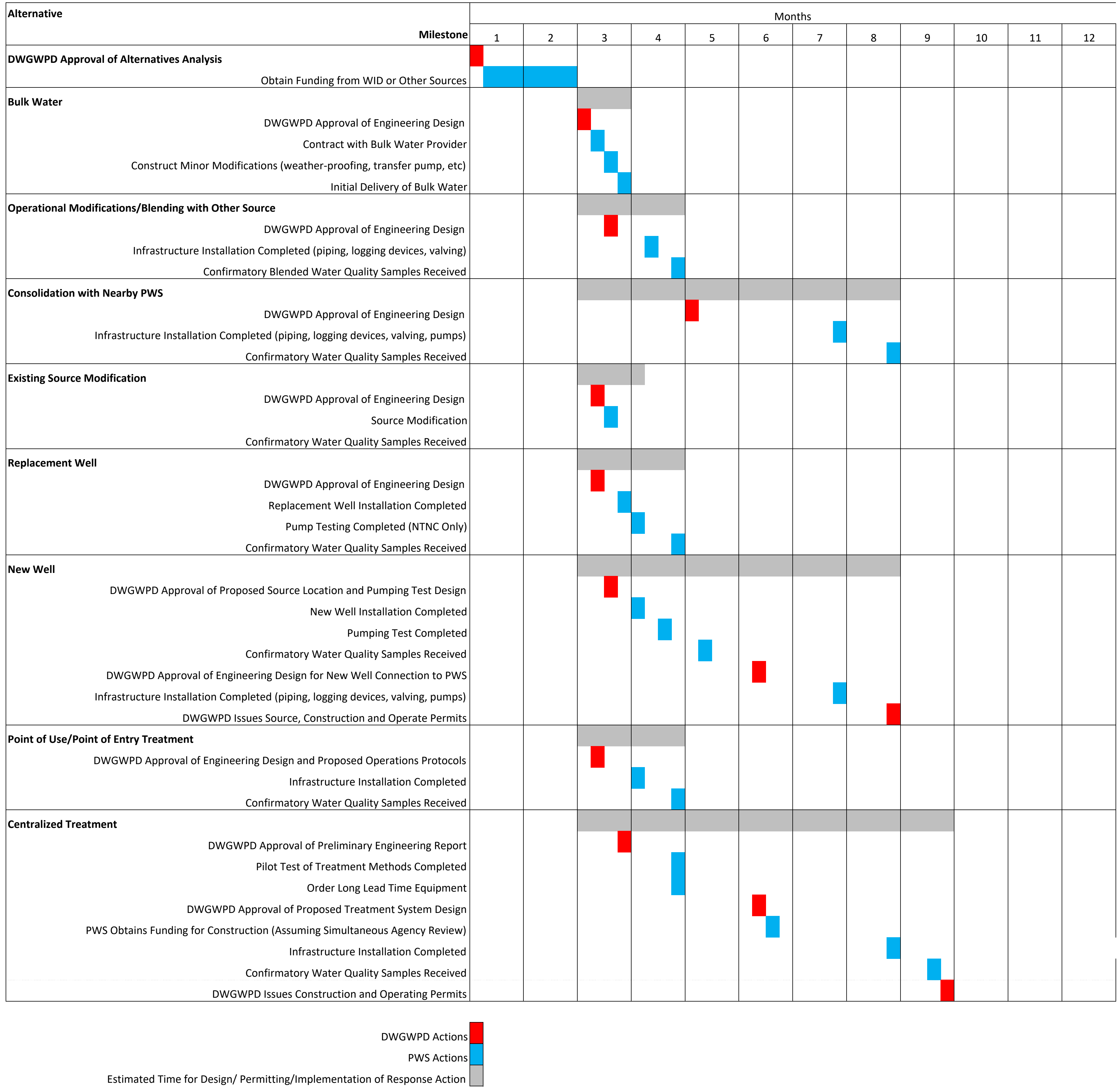


Figure 3
PFAS Response Plan
Conceptual Short/Long Term Alternative Implementation Milestones



4.2 Emergency Response

If the laboratory data from the initial sample contain regulated PFAS concentrations that exceed 40 ng/L in sum, or if the mean concentration of regulated PFAS from the initial and confirmation sampling results exceed 20 ng/L in sum, DWGWPD will send an NOAV requiring the PWS owner to issue a "Do Not Drink" notice (WSR Subchapter 21-10, Section 10.2.3) and take additional actions (refer to Section 4.0 of this PFAS Response Plan). The "Do Not Drink" notice must be issued within 24 hours and direct the PWS users to a source of drinking water known to meet state and federal drinking water standards.

The NOAV will require the PWS Owner to provide an "Emergency Response" plan and proposed schedule to DWGWPD and WMPD within 7 calendar days of issuance of the "Do Not Drink" notice. **The PWS will communicate its proposed emergency response plan to the DWGWPD and obtain approval prior to implementing the response.** The Emergency Response plan shall include those measures that can be implemented as soon as feasibly possible. PWSs should consult the Contingency Plan contained in the system Operation and Maintenance Manual for potential emergency response actions.

Typical emergency response measures include the following:

- Direct users to utilize Bottled Water
- Coordinate Bulk Water Hauling for use in the existing distribution system
- Blending with other existing permitted or unpermitted sources determined to meet safe drinking water standards for acute contaminants as established in Appendix A, Table A11-6 of the WSR and the interim PFAS standard established by VT Act 21. (Additional water quality sampling per WSR (21-6 or Table A11-6) will be necessary if blending is to be utilized as a Long-Term Response)
- Point of Use Treatment (likely only viable for some NTNC systems)

The PWS shall confirm that any bottled water, bulk water hauling supplier and blending source water proposed for use has completed the state's required testing for Regulated PFAS compounds.

Upon completion of emergency response implementation, the PWS shall obtain an approval letter outlining proposed response tasks and timeframes for emergency response implementation and completion of short-term and/or long-term response action alternative analyses and their implementation. The approval letter will be jointly issued by DWGWPD and WMPD to authorize the PWS to take action and to specify that an alternatives analysis be performed to satisfy potential cost recovery requirements as required by WMPD Emergency Response Plan (EPR), Chapter 35, Investigation and Remediation of contaminated Properties Rule, July 6, 2019 (I-Rule).

4.3 Short-Term Response

Once the Emergency Response is implemented the PWS should begin preparation of an Alternatives Analysis evaluating methods for correction of the PFAS impacts to the source. The Alternatives Analysis must be performed in consultation with a professional engineer familiar with public PWS design and permitting. Alternatives to be reviewed must include, but not necessarily be limited to: operational changes, potential replacement source development, potential new source development, consolidation with a nearby permitted system, and lastly installation of treatment. The potential for the short-term response to become the long-term (i.e. permanent) response should also be considered.

The DWGWPD will review and comment on the Alternatives Analysis and issue a document (approval letter or Permit to Operate) which will include tasks and timeframes for completion of the response. After a short-term response is approved, the PWS will need to implement the response.

Once the PWS has implemented the short-term response and provided confirmatory water quality sampling results that meet the applicable regulations, the DWGWPD may issue a letter of approval or revised Permit to Operate which will incorporate the implemented short-term response.

4.3.1 *Engineer's Alternative Analysis Report*

The Alternatives Analysis Report is necessary to satisfy requirements for both the DWGWPD and WMPD for the basis of the response chosen. The Alternatives Analysis Report will also provide justification for the response action chosen to satisfy cost recovery requirements for the WMPD. The report must include the elements necessary in WSR Appendix A, Part 1 to support design basis for a construction permit. The report must also contain the items required by the WMPD Evaluation of Corrective Action Alternatives (ECAA) to support both potential cost recovery and I-Rule requirements. The Alternatives Assessment Report will include assessment of the following for each of the Alternatives listed above:

- Overall protection of human health. Overall protection of sensitive receptors shall also assess long-term effectiveness and permanence, short-term effectiveness, and compliance with federal, state, and local laws.
- Compliance with legal requirements. Alternatives shall be evaluated to determine whether the PWS can obtain all federal, state, and local permits for the proposed alternative as well as describe how the alternative will meet those regulatory requirements.
- Long-term effectiveness and permanence. Alternatives shall be assessed for long- term effectiveness and permanence. Adequacy and reliability of the proposed alternative should be discussed including the uncertainties and risks associated with long-term operation and maintenance.
- Ability to reduce toxicity. The degree to which alternative reduces toxicity for PWS users.
- Short-term effectiveness. The short-term impacts of alternative shall be assessed by considering the following:
  - Short-term risks that might be posed or reduced for PWS users during implementation of an alternative;
  - Potential environmental impacts of the response alternative and the effectiveness and reliability of the alternative during implementation.
- Implementability. The relative degree of difficulty in implementing the alternatives shall be assessed by considering the following:
  - Technical feasibility, including technical difficulties and uncertainty associated with construction and operation, the reliability of the technology, and the ability to monitor the alternatives effectiveness;
  - Administrative feasibility, including activities needed to coordinate with other offices and agencies and the need to obtain any necessary approvals and permits; and
  - Availability of services and materials, including the adequate off-site treatment, storage capacity, and disposal capacity and services; the availability of necessary equipment and subcontractors, and any necessary additional resources.
- Cost. The types of costs that shall be assessed include the following:
  - Capital costs;
  - Annual operation and maintenance (O&M) costs;
  - Replacement costs;
  - Costs to implement land use restrictions;
  - Net present value of capital and O&M costs; and
  - Disposal costs.

- Environmental impact and sustainability. Include a discussion of waste generation and disposal requirements, as well as a discussion of methods to implement best management practices to reduce the environmental impact of the proposed alternatives in accordance with US EPA guidance or ASTM Standard Guide for Greener Cleanups.
- Community acceptance. This assessment includes determining which components of the alternatives interested persons in the community may support, have reservations about, or oppose. The Secretary may require a public comment period and informational meeting on the alternatives or consider community acceptance in the context of public input on the short-term response plan.
- Assessment of potential funding options must be considered. One option includes the Drinking Water State Revolving Loan Fund (DWSRF), administered by VTDEC Water Infrastructure Division (WID).

4.4 Long-Term Response

After the DWGWPD has issued a letter of approval and a revised permit to operate incorporating the selected short-term and long-term response action, the PWS must obtain Source and Construction permits as required to attain compliance with the WSR. This may be follow-up work associated with the short-term response to become in compliance with the WSR or it could also require design and costing of a new, fully complying long-term response action (i.e. new well, consolidation, treatment).

The DWGWPD may instruct the PWS owner and operator to develop and submit a Preliminary Engineering Report (PER) in accordance with Appendix A of the WSR. DWGWPD will communicate with the PWS owner and operator on developing the PER, which will incorporate the tasks and timeframes needed to implement a long-term remedy for the existing PWS. The PER may also be incorporated into an Evaluation of Corrective Action Alternatives (ECAA) directed and approved by WMPD. Coordination with potential funding agencies will occur if they are providing funding.

4.5 Waste Management and Prevention Division (WMPD) Coordination

In accordance with Act 21 the DWGWPD will notify the WMPD of the presence of Regulated PFAS >20 ng/L in a PWS. Throughout the response action process, the DWGWPD will coordinate with the WMPD and PWS owners to attempt to identify the RP who released the PFAS related contaminants identified in the PWS.

The WMPD will require investigation and remediation of the PFAS contamination in accordance with the Emergency Response Plan of the Environmental Protection Rules (EPR) Chapter 35, Investigation and Remediation of Contaminated Properties Rule, July 6, 2019 (I-Rule). In cases deemed "an immediate and serious threat of harm to human health and the environment" by the WMPD, they may require or undertake an emergency response (10 V.S.A.§6615) prior to performance of a site investigation or notifying the RP (10 V.S.A. §1283; §35-102(e)). Typically, the WMPD will direct a RP to perform investigation and response actions to address short-term impacts to sensitive receptors and impact to human health.

In the event the RP is unwilling, unable, or unknown, the WMPD may perform the investigation and remedial actions and seek reimbursement/redress from the RP at a later date as allowed by 10 V.S.A. §1283. The PWS may also be able to seek cost recovery from the RP for emergency, short-term and long-term response actions associated with implementation of this Plan. The likely success of PWS redress from the RP will be predicated upon performing and documenting an alternatives analysis. **It is essential that the PWS document the alternatives analyses performed <u>prior</u> to implementing their response action(s).** This will provide justification for the type and cost of response action(s) implemented. The Plan process will also provide the concurrence of the DWGWPD and WMPD regarding the response action(s) implemented, further bolstering the PWS ability to seek redress from the RP.

If the PWS has not yet done so, the WMPD may require the RP to perform the DWGWPD PFAS Response Plan related alternatives assessment, permitting and implementation of the short-term and long-term response actions at an impacted PWS as part of the investigation and remediation of hazardous materials and pursuant to 10 V.S.A. §6602(16) and §6615. The WMPD will direct the RP to conduct the alternative that will provide the most time effective and long-term response to provide potable drinking water to the PWS users. All remedies will need to comply with the I-Rule.

The WMPD may issue a First Letter to the RP requesting actions consistent with 10 V.S.A. §35-3 of the I-Rule. The objectives of the site investigation include:

- Development of a Conceptual Site Model (CSM) in accordance with §35-303;
- Identify the source, degree, and special extent of contamination in all impacted or potentially impacted environmental media;
- Identify pathways that are conveying or could convey hazardous materials to sensitive receptors;
- Identify sensitive receptors that have been or may be impacted by the release;
- Identify data gaps that must be addressed to confirm the CSM or evaluate corrective action alternatives; and
- Identify the need to conduct further investigation or corrective action based upon the results of all site characterization data gathered to date.

Due to the presence of the regulated PFAS in the water supply above the interim standard, the RP will be required to perform corrective actions upon a finding by the Secretary that the site investigation has adequately defined the extent of contamination (§35-601, -602). The first step towards initiating corrective actions is to perform an Environmental Cleanup Alternatives Analysis (ECAA) (§35-604). The ECAA must evaluate potential remedial methods for the Site to determine the corrective action that will eliminate exposure pathways to sensitive receptors. The portion of the ECAA addressing elimination of exposure to PWS users should be very similar to the alternative's analysis required by the DWGWPD PFAS Response Plan, the alternatives analysis described earlier may be used in this portion of the ECAA once the alternatives analysis has been approved by VTDEC.

Upon ECAA review and concurrence by the WMPD and DWGWPD a Corrective action Plan (CAP) will be generated. The CAP will detail how the remedial methods selected in the ECAA will be implemented. This may include source reduction (i.e. soils removal in areas of AFFF use), groundwater plume capture and treatment and/or other methods for plume reduction. If not already implemented, the CAP will detail the design and implementation of the DWGWPD PFAS Response Plan short and/or long-term response actions. The CAP will also include descriptions of the permitting required, milestones for implementation, timeframes and costs for implementation. Discussion of any required long-term monitoring will also be presented.

Completion of the site investigation and remediation in accordance with the I-Rule can require many months to years of effort. The DWGWPD and WMPD will work collaboratively to assure implementation of a long-term response for the PWS in as timely a manner as possible.

5.0 RESPONSE ACTION ALTERNATIVES

5.1 Summary of Response Action Alternatives

The following response actions are presented in the context of emergency, short-term and long-term measures for a PWS. An Alternatives Analysis **must** be performed following the **initial emergency** response as part of the preparation of **short-term** and/or **long-term response recommendations**. It is important to note that the PWS user impacts need to be resolved as quickly as possible, but that the short/long term responses **MUST** be proposed by the PWS and their professional engineer and approved by the DWGWPD and WMPD **PRIOR** to implementation. If a RP is identified the WMPD will direct the RP to conduct any of the following alternatives below that will provide the most time effective and long-term remedy to providing clean drinking water to the water system users. All remedies will need to comply with the WSR and I-Rule. The following alternatives are described in this section:

Table 3. Summary of Response Action Alternatives

Alternative	Likely Response Type	Implementation Timeframe	Rough Estimate of Capital Costs	General Assumptions
Bottled Water	E, S	< 1 week	$200 to $300 per 100 gal	does not include administrative costs
Bulk Water Hauling	E, S	< 1 month	$100 to $150 per 1,000 gal	an existing tank and no post disinfection
Operation Modifications – Blending with Other Source	E, S, L	< 1 month	$2K to $10K	minor modifications to piping, controls and metering
Consolidation with Nearby System	E, S, L	6 to 12 months	$50 to $150/LF $150 to $250/LF $50,000+ $2 to $3/gal	cross country buried pipe urban buried pipe booster pump station storage tank
Modifications to Existing Well	E, S, L	< 1 month	$2K to $5K	replacement of pitless, installation of secondary seal
Replacement Well	E, S, L	< 2 months	$15K to $20K $25 to $50/LF	meeting §21-4, 4.0.2 of WSR
New Well	S, L	4 to 6 months	$40K to $60K	follow WSR Source Permitting
Point of Use Treatment	E, S, L	< 1 week	$750 to $2K *per fixture*	installed by licensed plumber operated by PWS
Point of Entry Treatment	E, S, L (NTNC)	1 to 2 months	$10K to $15K *per POET*	installed by licensed plumber operated by PWS
Centralized Treatment	S, L (CWS & NTNC)	3 to 12 months	$25K to $75K $200K to $500K	<10 gpm 20 – 50 gpm

E – Emergency; S – Short Term; L – Long Term

5.2 Public Non-Transient Non-Community and Community Water Systems

The response actions described in the above section and later in this plan must be in conformance with the permitting provisions of the WSR regarding water source development, testing, design and operation and maintenance. The following section of this Response Plan provides guidance for both NTNC and CWS water systems defined as:

- **Non-Transient Non-Community (NTNC):** Regularly serves at least 25 of the same persons daily for more than six months per year. Examples: schools, factories, office buildings. For NTNC technical standard requirements under the WSR, see Appendix A, Part 11.
- **Community Water System (CWS):** Serves at least fifteen (15) service connections used by year-round residents or regularly serves at least 25 year-round residents. Design requirements are detailed in the WSR Appendix A Part 2 – Part 10 and Part 12.

5.3 NSF/ANSI 60 and 61 Requirements

All wetted parts of infrastructure for PWS must meet the following standards:

- **WSR (§ 21-7)** “*Facility and Operation Requirements*” for wetted parts to meet NSF standards
- **NSF/ANSI 60** “*Drinking Water Treatment Chemicals*” for chemicals which are used to treat drinking water
- **NSF/ANSI 61** “*Drinking Water System Components*” for all devices, components and materials which contact drinking water

5.4 Bottled Water

5.4.1 *Basic Overview*

If the PWS decides to use bottled water it can do so without any further approvals under WSR §21-3, 21-3.0.3 (Permits – Administration). Bottled water can be purchased in cased bottles or up to 5-gallon jugs with a dispenser. The following website lists bottled water suppliers the DWGWPD has received water quality data from which meet WSR water quality standards (including for PFAS):

https://dec.vermont.gov/water/drinking-water/public-drinking-water-systems/imported-bottled-water-non-vt-water-sources

If bottled water is a selected response by the PWS, it may be responsible for the costs. Under the I-Rule § 35-102 €(2)(B) (Emergency Response) and 10 V.S.A §6615. WMPD may also direct the PWS to provide bottled or bulk water. When PWS users are provided potable drinking water via bottled water, the PWS shall continue to work with the DWGWPD to determine short and/or long-term responses. The PWS will remain on a DND until such time as a long-term response has been employed and the water provided to the users from the permitted system is determined to meet safe drinking water standards.

5.4.2 *Likelihood of Achieving a Short or Long-Term Solution*

Bottled water obtained from a tested source is considered a short-term solution. PWSs may only use bottled water on a temporary basis to avoid unreasonable risk to health.

5.4.3 *Pros & Cons*

It will be important to accurately predict the quantity of water needed and coordinate this with the supplier. Changes in the quantity of water required will require advanced planning. The PWS should plan to warehouse a sufficient quantity of bottled water where it is being distributed. If for some reason, a scheduled delivery is delayed, there is a chance that the supply of bottled water could become exhausted until the next delivery is received.

5.4.4 *Estimated Costs*

Costs	Task Description
$2 to $5 per gallon	Bottled water by the case for volumes less than 1 gallon to 5-gallon jugs

5.4.5 *Implementation Timeframe*

Bottled water can typically be arranged immediately or within a few business days. The PWS would set up a delivery schedule with its vendor to get bottled water to all System Users on a regular basis (likely weekly deliveries).

5.4.6 *Technical Requirements*

- The selected bottled water supplier shall meet all WSR regulations and meet all PFAS related concentrations under Act 21. Technical and administrative guidance may be found in the WSR Subchapter 21-11 (Bottled & Bulk Water) Section 11.1 (Bottled Water). A list of tested bottled water suppliers will be posted on the DWGWPD website listed above.
- PWS shall confirm the supplier's ability to provide the amount of bottled water required and meet the time requirements needed to supply adequate drinking water to system users.
- The selected bottled water supplier shall meet all WSR regulations and meet all PFAS related concentrations under Act 21.
- The PWS shall set up a location for users to pick up bottled water.

5.5 Bulk Water Hauling

5.5.1 *Basic Overview*

The water system would engage with a PCWS and a Vendor to make routine deliveries of bulk water to the Water System. Typically, a tanker truck would be used to deliver water into the impacted PWS's storage tank(s). This alternative works well as a short-term or emergency response action for PWS that include storage tanks and booster pump stations as part of their permitted infrastructure.

Bulk water must be obtained from a CWS that meets all applicable water quality criteria, including interim drinking water standard for PFAS established in Act 21. Issuing a water conservation notice to PWS users is an integral part of utilizing bulk water as it reduces the volume of water needed to meet daily user demand needs. Technical and administrative guidance may be found in the WSR Subchapter 21-11 (Bottled & Bulk Water) Section 11.2 (Bulk Water) and Practice 98-09 on the DWGWP website (accessible via this hyperlink). PWSs employing bulk water hauling are required to routinely submit notification forms to DWGWPD (blank forms are available via this link and via this link). If bulk water is selected by the PWS, it understands that it may be responsible for the associated costs. If a RP is identified other than the PWS, then there may be the opportunity for cost recovery if the WMPD required actions are completed (e.g. I-Rule). When PWS users are providing potable drinking water via bulk water hauling, the PWS shall continue to work with the DWGWPD to determine a long-term solution. The PWS will remain on a DND until such time the water in the system is sufficiently blended thereby having PFAS reduced to acceptable levels.

5.5.2 *Likelihood of Achieving a Short or Long-Term Solution*

Bulk water obtained from an approved source can be either a short or long-term solution. This method is appealing on a short-term basis where there is an existing water tank available and connected to the system. It can be as simple as turning off the contaminated well and filling the tank with hauled water.

5.5.3 *Pros & Cons*

- If the PWS already has a tank, booster pumps and disinfection system then setting up a schedule for receiving deliveries and operating the system will be rather easy to do.
- If for some reason, a scheduled delivery is delayed, there is a chance that the supply of water could become exhausted before the next delivery is received. If depressurization occurs the system is required to issue a boil water notice to users and address adequate disinfection and testing once the system is pressurized.
- As a long-term solution, the cost becomes less appealing to other potential alternatives. There is an on-going administrative process to make sure water deliveries are received as needed.

5.5.4 *Estimated Costs*

Costs	Task Description
$100 to $150 (per 1,000 gallons)	when delivered by a larger transport truck (i.e. 4,000 to 8,000 gallons±)
$500 to $750 (per 1,000 gallons)	when delivered by a smaller transport truck (i.e. 1,000 gallons±)

Notes:

1. *Bulk water hauling costs are billed on a per load cost plus a transport fee based on the mileage.*
2. *Additional cost may apply if there is: the need to install a temporary water tank, weatherproofing, pumping to unload the truck; extended transportation; or delays for unloading the water from the truck.*

5.5.5 *Implementation Timeframe*

Scheduling bulk water deliveries can typically be arranged immediately or within a few business days. If other improvements are required such as placing a tank, booster pump and disinfection system then lead times may be several weeks to a couple of months.

5.5.6 *Technical Requirements*

The receiving PWS shall confirm they have an adequate way to supply drinking water via bulk water hauling truck.

- Does the System have a water storage tank/reservoir that can be filled? System shall discuss with DWGWPD whether existing water in tank can be used when blended or if needs to be removed prior to filling with bulk water.
- Does the PWS have a connection point where the tanker can connect directly to the system?
- Does the system have the pumping capacity to achieve this?
- Can the system be modified to provide water via tanker truck?
- If a direct connection is made (without a tank/reservoir) can the hauler company leave tankers for an extended period? Provisions for freezing will need to be considered.
- If tankers are limited to certain timeframes at the site, the PWS shall consider other options of providing safe drinking water (bottled water in combination with tankers?) to the system users.
- Follow provisions under:
    - WSR Subchapter 21-11, section 11.2.3 (Tanker Requirements for Hauling Water)
        - use only proper materials suitable for contact with potable water for tanker, hoses, valves, and other appurtenances
        - develop and adhere to a Standard Operating Procedure (SOP); has an SOP been developed an interim measure for consideration and approval?
    - 10 VSA, Section 1671 - Is the truck dedicated for the provision of drinking water as defined by statute?
    - WSR Appendix A, Part 8 (Distribution Systems) Subpart 8.11 Water Loading Stations
    - WSR Appendix A, Part 7 (Finished Water Storage)
    - WSR Appendix A 11.2 - Source and water quality requirements
    - WSR Subchapter 21-8 Cross Connection Control - water deliveries are to be overseen by a certified water operator. Provide provisions to avoid backflow and cross-connections during deliveries.

- Will the wholesaler provide drinking water with a free chlorine disinfection concentration that can be measured and maintained through the receiving storage vessel and into the receiving water system? Does routine coliform monitoring indicate that the drinking water is absent of bacteriological contamination?

The PWS operator is responsible for and should be present during each water delivery to review the process and observe the water is received with an adequate chlorine residual generally between 1.0 to 2.0 mg/L, but no less than 1.0 mg/L (see Section 11.2.2(c) of the WSR). A chlorine residual will need to be maintained in the tank so there is adequate disinfection throughout the distribution system. All chlorine used must be NSF 60 certified. The operator will be required to record daily totalized meter readings of water usage and free chlorine residual. PWS operators must take one total coliform sample from distribution following each load of bulk water received.

Table 4. Chlorine Dose Calculation using 12.5% Sodium Hypochlorite

Volume of 12.5% Sodium Hypochlorite (ounces)	Volume of Water (gallons)	Concentration of Mixed Sodium Hypochlorite (mg/L)
1	1,000	1
2	1,000	2

Once the first delivery of water is received from an approved community water system supply source and introduced into the tank, free chlorine disinfection residual monitoring, flushing of the system as appropriate, is necessary to appropriately distribute the new water throughout the system.

If the PWS uses water hauling tankers, they shall consider implementing water conservation measures to reduce the overall PWS's demand for water and limit the number of trucks required to save drinking water for its users.

See Bulk Water Hauling as an Emergency Source Notification Form

- *https://dec.vermont.gov/sites/dec/files/dwgwp/DW/bulkwaterhaulingform.pdf*
- Also see the Extended Time Bulk water hauling form to be submitted weekly for use of bulk water as a drinking water source

5.6 Operational Modifications/Blending with Other Source

5.6.1 *Basic Overview*

For a PWS that has more than one source, discontinuing use of the PFAS contaminated well or a mixed ratio blend may provide water that meets drinking water criteria. This alternative will likely not be available to many PWSs, but if it should be determined to be applicable, then it may be the quickest and least costly alternative.

Water conservation efforts should also be an integral part of this alternative. When evaluating blending as an alternative, the system must consider applicable standards of the system and source types such as NTNC and PCWS. Ultimately, the goal is to reduce regulated PFAS concentrations to either non-detect or low enough to have a weighted concentration of regulated PFAS compounds reliably less than 20 ng/L and meet all other water quality requirements in the WSR in the blended water.

One of the first questions is, does the PWS have an additional permitted or unpermitted source available, or is there another nearby water system with capacity (quantity and quality) to serve? If the other source is permitted and suitable to serve the system in need, or there is a nearby system with capacity, then it can quickly be evaluated to see if water quality from blending will provide an overall reduction of PFAS to acceptable levels. It is possible that a mixing basin/tank will be needed to achieve consistent and reliable water quality in the distribution system.

If there is another well that happens to be an unpermitted or emergency source, then the system must perform water quality testing as required for either serving an NTNC or CWS and demonstrate that the source meets water quality standards, and when blended, will provide an overall reduction of PFAS to acceptable levels (<20 ng/L).

5.6.2 *Likelihood of Achieving a Short or Long-Term Solution*

This alternative could be either a short and/or long-term solution. The alternate source must be evaluated to determine if pumping over time may diminish the reliable pumping withdrawal rate and/or may draw in the PFAS that could render this alternative as an unacceptable long-term solution. Or, the blended well may serve as a short-term solution while another alternative such as a new well site is being evaluated.

5.6.3 *Pros & Cons*

This method could be quick and easy to implement if the necessary yield and water quality data are available. Depending on the yield and water quality of the alternate source there may need to be some additional efforts by the operator. The PWS may also need to look at conservation water saving measures. Each well must have a totalizing flow meter, control valves and usage is to be recorded daily.

5.6.4 *Estimated Costs*

Costs	Cost Description
variable	If blending is possible the costs incurred may include: connection to the other source with piping, valves and appurtenances; installation of meters and possible logging devices; testing of the blended source, operation and maintenance; and fee for additional water if from a source other than the owner. The initial costs depending on the distance of interconnection may be between $5,000 to $20,000.

5.6.5 *Implementation Timeframe*

Implementation time is highly variable and dependent upon site-specific characteristics. Implementation times could be as short as a week for a PWS with existing infrastructure in-place to support this alternative. For example, a PWS with multiple supply sources may be able to discontinue use of a contaminated supply source and issue a water conservation notice to the system's users in a relatively short period of time. Conversely, if construction of additional drinking water infrastructure is required, implementation of this alternative could take several months.

5.6.6 *Technical Requirements*

- Each source must be sampled for PFAS.
- Each source must be metered, have appropriate control devices to provide for treatment reliability and to report production daily.
- Automated flow control valves or devices will be required to provide consistent and reliable operation and monitoring of blending treatment.

- If multiple sources cannot be effectively flow paced, then a storage tank may be needed to aid in blending prior to distribution.
- Other sources may require pumping to waste and analytical testing prior to use.
- A sampling tap is required immediately prior to distribution

5.7 Consolidation with Nearby PWS

5.7.1 *Basic Overview*

This option can only be considered if there is a nearby PWS that has the capacity to provide water and desire for consolidation. Consolidation is not always easy to achieve, but when the possibility exists, consolidation is a recommended alternative. Consolidation is recommended since it creates a larger number of users and increased technical, financial and managerial resources available to the PWS. Though there may be compelling technical reasons for consolidation, this is not usually an easy decision for communities to adopt.

Based on technical construction requirements, a CWS can only be serviced by another CWS on a long-term basis. Conversely, a CWS can serve an NTNC and a TNC system, and an NTNC can serve another NTNC system and TNC systems. Other options may be permitted on an emergency or short-term basis only and as approved by the DWGWPD and with demonstrated performance.

5.7.2 *Likelihood of Achieving a Short or Long-Term Solution*

If there is a suitable system that is within a reasonable distance to provide an interconnection, then this alternative can provide a long-term solution. An NTNC may be allowed to serve a CWS on an emergency or short-term basis if it can provide documentation of performance such as having adequate quantity and quality.

Is construction of a connection to a nearby system reasonable?

- Can the connection be made with significant system upgrades (pump stations, storage tanks, etc.)?
- Distance between systems needs to be considered.
- Are pumping, treatment and storage systems necessary?
- Necessary modifications to your own system to accommodate new connection?
- Can a short-term consolidation turn into a long-term solution?

5.7.3 *Pros & Cons*

Consolidation utilizes and maximizes the potential for existing infrastructure and provides a level of efficiency. One of the con's is that there is usually a strong desire for a current water system to maintain control of their water system and administrative processes.

5.7.4 *Estimated Costs*

Costs	Task Description
variable	The costs will be highly variable depending primarily on the linear footage of piping to interconnect the systems. Depending on the piping material, diameter and location, this can cost between $50 to $100 per linear foot for cross country installations up to $250 per linear foot under roadways in urban areas. There will be other initial costs such as a meter installation and legal fees to setup an agreement and establish a rate structure. Additional items that may be required and costs includes a pump station ($50,000+, PRV or PSV in vault ($20,000 each).

5.7.5 *Implementation Timeframe*

This alternative will include planning, design and construction. It will likely take as little time as 6 months to as much as 18 months. (funding - planning, design, bond vote, construction)

Is construction of a connection to a nearby system reasonable to perform in a short time?

- Are any significant upgrades required that will impact timing as described below in technical requirements?
- Distance between systems needs to be considered.
- Can a short-term consolidation turn into a long-term solution or will another short-term alternative be required while seeking consolidation as a long-term solution?

5.7.6 *Technical Requirements*

Some typical items are listed below and additional requirements to be determined on an individual basis by the PWS, professional engineer and DWGWPD.

- Issues that could restrict a piped connection between both systems such as land ownership, shallow bedrock, or other factors.
- based on system hydraulics the following may be required: pump station, storage tank, pressure reducing valve (PRV) or pressure sustain valve (PSV). All can be located in either an existing building if there is space, a new building or in a new buried vault.
- all consolidated systems will have a flow meter, backflow protection device (if applicable) and sampling tap at the connection point.

5.8 Existing Source Modification

5.8.1 *Basic Overview*

Review specifications of existing source and identify if there are any recommended modifications that may improve water quality. Many wells constructed prior to 1992 were installed with limited casing lengths into bedrock and no grouting. These conditions may allow for shallow PFAS containing groundwater to enter the well. These “defects” in well construction may be remedied through well modification. Source modification assumes that a down well video will be taken and that there is a reasonable likelihood that there is PFAS laden groundwater infiltration occurring to the well either from a leaking pitless adaptor, failing seal of the casing into the bedrock or from a distinct shallow fracture. The modifications could include replacement of the pitless adaptor or installation of a secondary well seal such as a Jaswell seal or packer with the annulus tremie grouted up to the ground surface.

Pitless adaptor

5.8.2 *Likelihood of Achieving a Short or Long-Term Solution*

For older wells that do not meet current construction standards, making improvements to the well may prove beneficial and resolve the issue. If the modification is successful, then this alternative could provide a long-term solution. Additional data may be necessary to justify that the modification will serve as a truly long-term solution. Evaluation of the bedrock structure, fracture sets, and geophysical measurements may be necessary to provide a justification of likely long-term effectiveness.

Jaswell Seal

5.8.3 *Pros & Cons*

If the repair is successful, ongoing operation and maintenance costs will be limited. Implementing a modification does not guarantee that there will be an improvement in the water quality. In addition, there may be a water quality improvement in PFAS concentrations. Installing a seal could reduce the functional yield of the well (by eliminating flow from the unconsolidated deposits aquifer into the well). The yield of the sealed well must be evaluated to determine whether the yield of the well will be adequate to meet the water system's water use demands. For noncommunity water systems, this evaluation must consider instantaneous peak demands and existing storage facilities and may necessitate a revised engineered design for the Water System, prepared in accordance with Appendix A, Part 11 of the WSR. will be a but a secondary seal could cause a reduced yield that may or may not result in a well with diminished yield and necessitate the provision of water storage for NTNC water systems.

5.8.4 *Estimated Costs*

Costs	Task Description
$3 to 4K	Video well to 500 feet – involves removal and replacement of pump
$1 to 2K	Replacement of pitless adaptor
$3 to 5K	Install Jaswell or packer seal at 100 feet and grout annulus
$3 to 5K	Packer test to identify water quantity to 500 feet

5.8.5 *Implementation Timeframe*

Initial assessment of the well regarding the well construction and review of area geology and nearby wells can be done in a matter of days. To perform a video and make modifications to the well can be done by one of several licensed well drillers within the period of less than one month pending their availability.

5.8.6 *Technical Requirements*

Modification of the well can be performed without obtaining Source or Construction Permits if the work is deemed to be **correcting a defect in the system** AND meets WSR Subchapter 21-4.0.2 (Exemptions from Source and Construction Permits) as "…….*minor alterations or maintenance of an existing water system, and no source permit will be required for minor maintenance such as replacement of source pump or source structure repair, which would not in and of itself affect the quality (adversely) or quantity of water service rendered, providing work is done according to the Vermont Standards for Water System Design, Construction and Protection (see Appendix A of this rule). It is recommended (strongly) that the water supplier contact the Secretary for consultation on plans for minor improvements. Water Services and Plumbing must adhere to the Vermont State Plumbing code of regulations, Appendix A, Part 8.9 of the WSR."*

This work is to be performed by a Vermont licensed well driller. Repairs can be made in less than a months' time. If a secondary seal is installed, there will need to be some level of testing performed to demonstrate the quantity and quality of the water from the modified well will be sufficient for the water system. If just the pitless adapter is replaced a sample will need to be collected and tested for regulated PFAS compounds.

5.9 Replacement Well

5.9.1 *Basic Overview*

If the modification to the existing well does not appear to be a preferred alternative, the system may want to consider installation of a "replacement well" that is near the existing well, constructed in accordance with or above the current standards (telescoping casing, extra casing length, grouting) and likely to be PFAS free. Significant knowledge of the aquifer is needed to provide confidence that a replacement well will provide sufficient water quantity and quality. Evaluation of the aquifer dynamics (geophysics, fracture trace, pump test results review), likely PFAS transport mechanisms and bedrock structure should be performed. In addition, the following conditions must be met to qualify as "a source structure repair" per 21-4, 4.0.2 of the WSR, thereby allowing installation without the need for source or construction permits.

Drilling of a replacement well comes with inherent risks. If the replacement well is desired to become the long-term response/permanent supply source for the PWS the technical requirements of Appendix A need to be met; Part 3 for PCWS and Part 11 for NTNCWS. There is flexibility in the application of these technical requirements in WSR Subchapter 21-3, 3.7.2 The variance criteria provide a method for the DWGWPD to permit alternatives to these requirements, if the performance criteria are met. These must be approved by the DWGWPD **prior** to implementation.

5.9.2 *Likelihood of Achieving a Short or Long-Term Solution*

If the new well provides the necessary quantity and quality of water, then this alternative will provide a long-term solution.

5.9.3 *Pros & Cons*

There is some level of risk constructing a new well near the old PFAS impacted well. If the impact is from an on-site source such as a septic system, then a new well with better construction techniques may resolve the contamination. Conversely, there is always a risk that this will not resolve the contamination and other alternatives will need to be considered.

5.9.4 *Estimated Costs*

Costs	Task Description
$25K to $40K	Drill new well to 500 feet with 100 feet of casing grouted, well pump, downwell pipe and electrical / assist with pumping test / abandon old well at 500 feet / interconnect with PWS / permitting, hydrogeo, engineering and water quality testing. Drilling $13/ft; Casing $21/ft; Grouting $19/foot; Well Abandonment $4/ft.

5.9.5 *Technical Requirements*

Modification of the well can be performed without obtaining Source or Construction Permits if the work is deemed to be **correcting a source structure repair** AND meets WSR Subchapter 21-4.0.2 (Exemptions from Source and Construction Permits) as "…….*minor alterations or maintenance of an existing water system, and no source permit will be required for minor maintenance such as replacement of source pump or source structure repair, which would not in and of itself affect the quality or quantity of water service rendered, providing work is done according to the Vermont Standards for Water System Design, Construction and*

Protection (see Appendix A of this rule). It is recommended that the water supplier contact the Secretary for consultation on plans for minor improvements. Water Services and Plumbing must adhere to the Vermont State Plumbing code of regulations, Appendix A, Part 8.9 of the WSR."

The following conditions must be met by the proposed replacement well based upon the type of PWS:

All CWS replacement wells must:

1. Constructed to at least the current Appendix A Part 12 standards, e.g. proper casing (>50 feet; see Appendix A 3.4.1.2) and grouting.
2. Constructed within Zone 1 of the Source Protection Area, or within 200 feet radius of the existing well, whichever is less. The PWS engineer will need to assess as part of the alternative analysis.
3. Able to meet all MCLs as listed in WSR Subchapter 21-6 and the current interim PFAS standard of 20 ng/L Regulated PFAS in Act 21. If treatment must be provided to meet the standards, that must be provided as part of the alternative analysis.
4. Able to meet current average day demand and maximum day demand, but no less than 245 gallons per day average day demand and 360 gallons per day maximum day demand per residential connection. Metered data will be recognized for this determination as allowed under Appendix A Part 2, but no less than 60 gallons per day per person (and a minimum of 3 persons per residential service connection) is to be provided.
5. Only to meet current demand needs. Increased source yield will not be recognized without performance of an appropriate pump test.
6. Ultimately permitted, as required by the WSR. See description of permitting flexibility already provided for in WSR Subchapter 21-3,3.7.2.

All NTNC replacement wells must be:

1. Constructed with grouted casing 10 feet into un-weathered competent bedrock, or with at least 50 feet of grouted casing.
2. Constructed within 10 feet of the existing well, or as otherwise determined to be acceptable by DWGWPD. The PWS engineer will need to assess as part of the alternatives analysis if a larger distance is desired (for example, to be further away from a leachfield as prescribed by Appendix A Part 11). Pump testing may be required to address potential contamination or adverse interference.
3. Able to meet all applicable MCLs as listed in WSR Subchapter 21-6 and the current interim PFAS standard of 20 ng/L Regulated PFAS in Act 21. In all instances the source shall be pumped at its maximum day demand design rate for a minimum of 24 hours before collecting water quality sample for analysis. If treatment must be provided to meet the standards, that must be provided as part of the alternative analysis.
4. Able to meet PWS design for current average day, maximum day and instantaneous peak demands (or to provide storage volume as necessary to meet IPD).
5. Only meet current system design needs. Increased yield will not be recognized without an appropriate pump test, as required by Part 11 of Appendix A of the WSR.
6. Pump testing to determine interference with nearby wells. This will be required if the replacement well is within 500 feet of an existing well, when the maximum day demand of the new well is less than 5 gallons per minute. Maximum day demands at or exceeding 5 gallons per minute will require a pump test and an interference determination (see part 11.6.3 of WSR) if off-site existing wells are within the distances specified in Table A 11-4 of the WSR.

7. An approval letter must be obtained for a replacement well and associated testing for quantity and quality. A permit or approval will be provided upon successful completion of the source improvement.

5.10 New Well Siting and Construction

5.10.1 *Basic Overview*

Evaluating if a new water source well can be located on PWS property that meets the WSR setbacks and can be constructed to provide necessary water quality and quantity should be considered. Regulations Governing NTNC and CWS PWSs related to new source construction is below:

- For NTNC systems
  - Subchapter 21-4 (Source and Construction Permits)
  - Appendix A Part 11 (Non-Community PWSs)
  - Appendix A Part 12 (Construction and Isolation Standards for Wells)
- For CWS systems
  - Subchapter 21-4 (Source and Construction Permits)
  - Appendix A Part 3 (Water Supply Source Development and Protection)
  - Appendix A Part 12 (Construction and Isolation Standards for Wells)
- Provide a work plan to the DWGWPD for review and approve proposed location available to the PWS for a new source supply well that would not be under the same influences as the existing well.
- Install the well, perform a yield test and collect water quality. As a short-term response, it would be appropriate to sample for acute contaminants (Table A11-6 and PFAS). As a long-term response, need to consider 21-6 requirements as they apply to CWSs and NTNCs.

5.10.2 *Likelihood of Achieving a Short or Long-Term Solution*

This alternative may achieve a long-term solution if there is a suitable location and the source quantity and quality is acceptable.

5.10.3 *Pros & Cons*

If a new well provides adequate quantity and quality of water, then the need for long-term treatment may be avoided. Even though a well is drilled in a different location there is always the possibility that there may be some level of PFAS contamination, monitoring should be considered as a long-term cost. Part of the evaluation must consider if the yield is sufficient; if not, consideration for storage should be evaluated.

5.10.4 *Estimated Costs*

Costs	Task Description
$50K to 100K	Drill new well to 500 feet with 100 feet of casing grouted, well pump, downwell pipe and electrical / assist with pumping test / abandon old well at 500 feet / interconnect with PWS / permitting, hydrogeo, engineering and water quality testing

- These costs do not include land acquisition or legal fees if necessary

5.10.5 *Implementation Timeframe*

This work is will be performed by a Vermont licensed well driller. A new well location will take longer than modifying an existing well or replacing an existing in a similar location. A new well under an emergency timeline may be able to be on line within 4 to 8 months.

5.11 Point of Use (POU) Treatment – GAC

5.11.1 *Basic Overview*

POU treatment systems generally refer to commercially available filters that mount under sinks or faucets throughout a facility where people may ingest water. Treatment is usually limited to those locations intended to provide drinking water; locations not typically associated with drinking (hose spigots, showers, toilets, etc.) are not treated. POU treatment units capable of treating PFAS are comprised of granular activated carbon. Treatment is discussed in detail in **Section 6** below.

5.11.2 *Likelihood of Achieving a Short or Long-Term Solution*

Because of the maintenance requirements and limited treatment scope, POU systems are generally only employed as temporary/emergency, short-term solutions to provide safe drinking water. POU systems must be monitored for water quality (PFAS, arsenic, coliform bacteria) and maintained by the PWS; this includes any replacement and disposal costs of the filter units. As the spent filter media contains PFAS, spent filter media must be disposed of in an approved manner.

5.11.3 *Pros & Cons*

POU systems can be advantageous because the individual units are small and can be quickly and easily installed at the drinking water distribution point. Treatment is localized to drinking water only, avoiding unnecessary time and expense spent treating water not intended for consumption. However, POU systems require time-intensive and expensive monitoring to ensure and maintain their effectiveness. GAC systems require media changeouts based on PFAS breakthrough which is associated with the amount of water treated and PFAS concentration. This is difficult to monitor as the units are dispersed across the distribution system and may be located in private residences or buildings. Furthermore, localized treatment does not eliminate all potential exposure, putting consumers at risk at the sites that are not treated. It should be noted that spent POU filters cannot be landfilled in Vermont.

5.11.4 *Estimated Costs*

Costs	Task Description
$750 and $2,000 (per fixture)	Individual POU units are relatively affordable, but depending on the size of the PWS, several units could be required to provide adequate treatment. The cost listed does not include the cost associated with sampling and monitoring of all POU systems.

5.11.5 *Implementation Timeframe*

POU systems can generally be installed within one to two weeks by a licensed plumber.

5.12 Point of Entry Treatment (POET)

5.12.1 *Basic Overview*

A point of entry treatment (POET) system can be utilized in a manner similar to POU treatment however rather than treating at the tap, water is treated as it enters the building. Though a POET can be considered a centralized treatment option, it is separated in this section due to its relative ease of installation with the following provisions. Under this Response Plan a POET system is applicable for the following conditions, otherwise it will be considered under the next section Centralized Treatment:

- Applicable for private, TNC, NTNC and select CWS such as small condo associations.
- WMPD may require a RP to pay for its installation, operation, maintenance and monitoring costs
- Utilizes two filtration vessels in series (lead/lag) using either GAC or ion exchange resin media for filtration
- Water quality would need to be assessed to determine pretreatment requirements..
- Is installed in line with a well pump prior to a hydropneumatic tank or atmospheric storage tank.
- Disinfection is required post filtration

5.12.2 *Likelihood of Achieving a Short or Long-Term Solution*

A POET system can achieve either a short or long-term solution. On a short-term basis it can be used to treat water while a longer-term solution is being designed. On a long-term basis it may be the only feasible alternative and can perform reliably.

5.12.3 *Pros & Cons*

- POET can be implemented in locations were POU treatment is not feasible due to the number of POU units that would be needed such as at schools, office buildings etc.
- The advantage of POET systems over POU is that all of the water entering a facility is treated rather than select taps.
- Good for lower flow rates (MDD applications as opposed to IPD). Should be situated prior to hydropneumatic tanks.
- Continuous monitoring and disposal costs may be prohibitive.
- Quarterly sampling for PFAS will be required as well as annual system maintenance.
- It should be noted that spent POET filter media cannot be landfilled in Vermont.
- Post contact disinfection with U.V. light may be considered when water distribution is within the same building, premise plumbing. Post contact disinfection with free chlorine is required for community water systems and in situations where more than one building service is being provided treated water following treatment.

5.12.4 *Estimated Costs*

Costs	Task Description

$10K to $15K (per POET)	POET systems are more expensive to install than POU systems, however there are typically fewer systems to install, sample, and maintain.

5.12.5 *Implementation Timeframe*

- POET systems can typically be installed within one week to one month by a licensed plumber. Once installed the DWGWPD will establish a monitoring schedule. In situations where there is no space requirement, a shed style building with conditioned space may need to be constructed.
- Perform water quality testing, as required by the treatment vendor, to make sure no pretreatment is required.

5.13 Centralized Treatment

If no other alternative discussed above appears likely to achieve a cost-effective long-term solution then the system will need to consider a centralized treatment approach as described in **Section 6**, Treatment Technologies. A treatment alternative for an impacted source should be considered as the last option. For some systems treatment may be more easily integrated if there is already some level of treatment and building space available, while for other systems it will be a major investment with on-going operation, maintenance and monitoring required. Treatment will also require additional administrative resources and will likely change the operator classification required. Process flow diagrams for centralized treatment using either GAC, resin or membrane filtration is shown below and discussed in detail in the next sections.

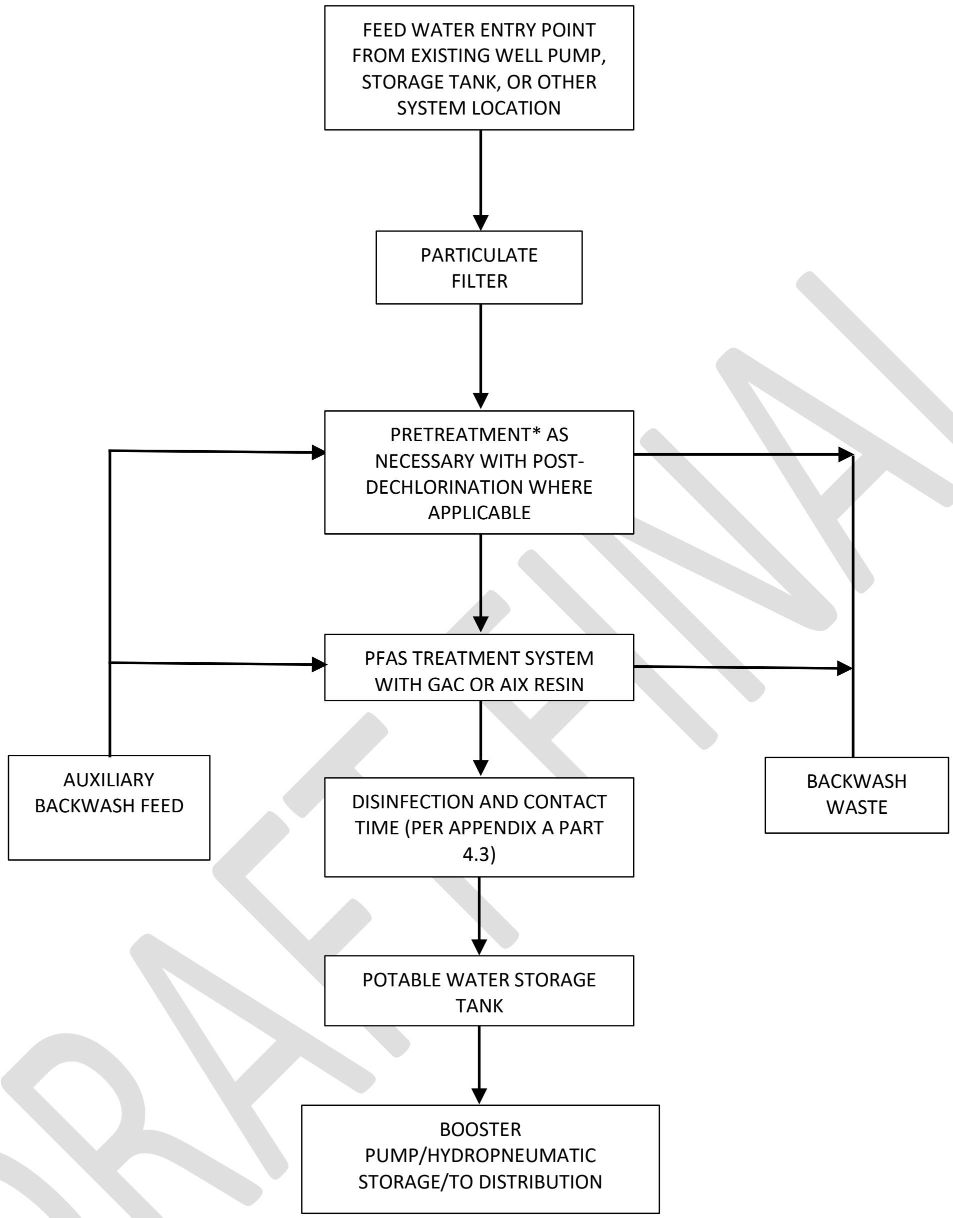


Figure 4 – Typical GAC or AIX Resin Process Flow

** Common pretreatment technologies for Vermont water include particulate filtration, iron and manganese removal, and softening.*

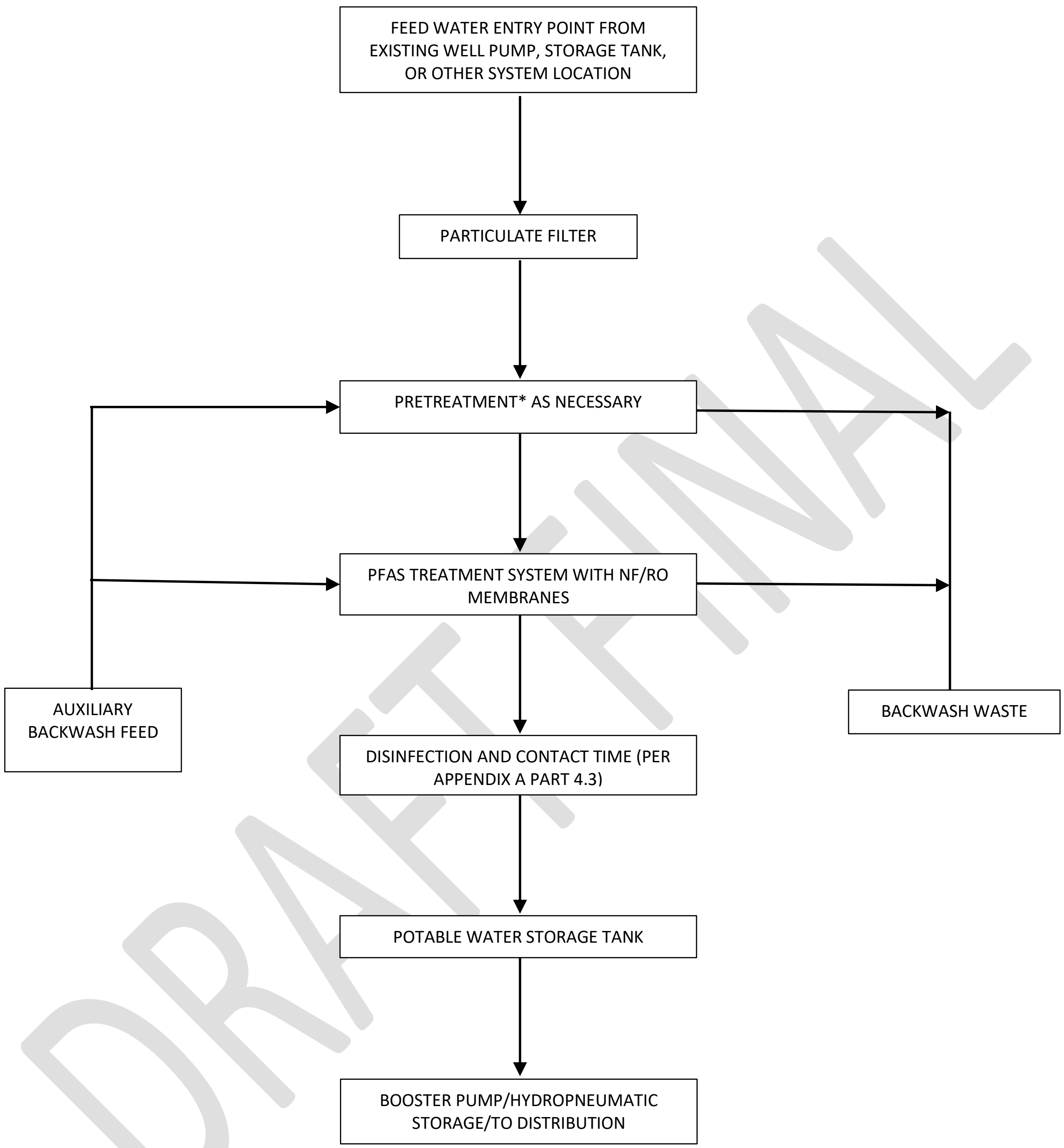
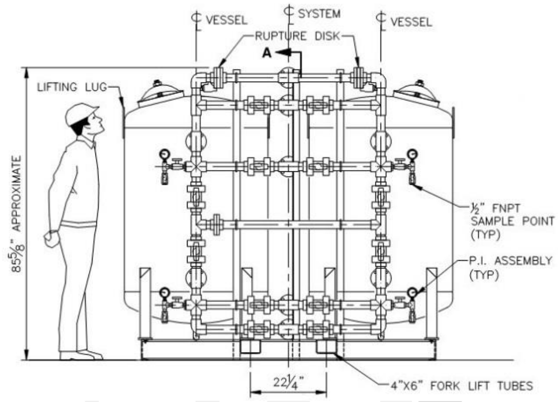


Figure 5 – Typical NF/RO Membrane Process Flow

* *Common pretreatment technologies include particulate filtration, iron and manganese removal, and softening.*

6.0TREATMENT TECHNOLOGIES

Centralized treatment consists of constructing a treatment facility to remove PFAS from all water produced from a PWS's supply source(s). Several different treatment technologies are proven to be effective at removing regulated PFAS from drinking water. However, the implementation timeline for centralized treatment is generally longer than other alternatives described in Section 5.of this PFAS Response Plan. Life-cycle costs (capital, operations, and maintenance costs) for centralized treatment may generally be higher than costs for other alternatives.



50 GPM GAC Filtration, Calgon

6.1 Basic Overview

The treatment technology best suited for a PWS will depend on the water quality but may also depend on the PWS size and system classification. Effective treatment of high capacity municipal well systems is generally undertaken at a centralized facility near the source. Current proven technologies for PFAS treatment include pressure filtration using granular activated carbon (GAC) for adsorption, anion exchange (AIX) resin media for adsorption and ion exchange, and membrane filtration, usually in the form of reverse osmosis (RO).

6.2 Treatment Considerations for 5, 10, 20 and 50 GPM Flow Rates

Treatment systems with capacities up to 5 gpm are suited for smaller PWSs. Often point of entry treatment (POET) systems are capable of functioning as centralized treatment systems for smaller PWSs. Treatment systems with capacities of 10, 20, or 50 gpm may consist of filters rated for higher flow or multiple banks of filters rated for a lower flow rate. As discussed in the previous section, all drinking water treatment chemicals and components are required to meet NSF/ANSI 60 and 61 criteria. Water quality testing will be important to address any pretreatment requirements.

Two lists of treatment vendors are provided in **Appendix B** that have provided general pricing and lead times and should not be considered quoted prices. One list is for equipment that is considered long-term treatment and is purchased. The other list is for treatment equipment that can be obtained on an emergency basis. Please note that these vendors are not endorsed by the agency but are offered for reference under this response plan.

6.3 NTNC versus CWS

Treatment considerations can vary depending on whether the system is classified as NTNC or CWS. Oftentimes, a NTNC system will not require the same redundancies as a CWS for pumping and treatment trains. This distinction is best understood through the following example: suppose a system is comprised of booster pumps and simple filtration. Systems classified as CWS are required to maintain two separate series complete with pumps and filters that are each individually capable to supply demands. Thus, it can shut down to perform system maintenance on one of the pump and filter lines. A CWS system may however be equipped with three separate series of pumps and filters, for which any combination including two of the three can supply demand. This would allow the system to temporarily turn one pump and filter line "off" for maintenance while the other two remain online. In contrast, a NTNC system would require only one pump and filter line, where the pump to filtration must meet the instantaneous peak demand of the system on its own. Some redundancy may be required to meet maximum day demands of the water system.

Some existing Public Water Systems (many existing NTNC and some existing CWS) may not have atmospheric storage, the well pump and casing may have been designed to meet instantaneous peak water use demands and to provide storage (casing storage). If centralized treatment is considered for these types of systems, atmospheric treatment and a booster pump station should be provided to meet IPD, the treatment should be designed to meet MDD flows of the system. The treatment vessels sized for MDD will be smaller than vessels sized for IPD and should provide superior performance as the treatment vessels will experience consistent flow conditions.

6.4 Operator Classification

Operator classification may be subject to change upon implementation of PFAS treatment pursuant to requirements of Subchapter 21-12 of the WSR. The addition of treatment may increase the operator Class requirement from a Class 2 to a Class 3 – refer to section 12.8 of the WSR (page 66).

6.5 Filter Comparisons

Table 5. Applicable Filtration Technologies

Treatment Technology	Effectiveness	Start-up and Operation	Typical Costs
Granular Activated Carbon (GAC)	▪ Less effective for short-chain PFAS compounds as compared to long-chain compounds* ▪ PFAS removal can be inhibited by high levels of organics in influent ▪ Often operated in lead-lag configuration to maximize filter media life ▪ Upstream pretreatment may be required pending water quality	▪ Easy to operate ▪ Requires post-filtration disinfection. Chlorine is required for community systems. Chlorine and/or UV may be acceptable for an NTNC system where all water use is within the building (premise plumbing; no buried piping)	▪ Lowest capital and filter media cost ▪ Cost for disposal of carbon
Anion Exchange (AIX) Resin	▪ Specialty anion resins designed to remove PFAS ▪ High removal efficiency and low contact time allow for smaller filters compared to alternatives ▪ PFAS removal can be inhibited if water has certain anions at high concentrations ▪ Often operated in lead-lag configuration to maximize filter media life ▪ Upstream pretreatment may be required pending water quality	▪ High demand for resin media can lead to market shortages ▪ Chlorine is required for community systems. Chlorine and/or UV may be acceptable for an NTNC system where all water use is within the building (premise plumbing; no buried piping)	▪ Media is more expensive than GAC, but uses less media and often longer lasting
Membrane	▪ Highest removal efficiency ▪ Will remove other contaminants of concern ▪ Upstream pretreatment may be required pending water quality to minimize backwash requirements	▪ Most operator intensive ▪ Additional chemicals required for cleaning or corrosivity treatment ▪ Reject water places a higher demand on source and requires additional treatment for PFAS disposal ▪ Chlorine is required for community systems. Chlorine and/or UV may be acceptable for an NTNC system where all water use is within the building (premise plumbing; no buried piping)	▪ Highest capital and O&M costs

**Long-chain PFAS compounds include perfluoroalkyl sulfonic acids with 6 or more carbon chains and perfluoroalkyl carboxylic acids with 7 or more carbon chains.*

6.5.1 *Granular Activated Carbon*

GAC historically is the treatment technology of choice for PFAS removal. There is abundant supply of GAC media in the marketplace, lowering costs and shortening equipment and media lead times. GAC removes PFAS through adsorption: PFAS is attracted to the carbon and binds to the surface of the filter media. Media can be manually loaded or educted into filter vessels, and, when exhausted, must be removed from the vessel and disposed of offsite. Refer to **Section 6.9.5** for specific details on waste disposal. GAC must be virgin and NSF 61 certified for use in drinking water applications. Reactivated GAC is not recommended for drinking water treatment due to potential for contamination of the water sypply via release of contaminants (such as arsenic) from the regenerated carbon media.

Empty Bed Contact Time (EBCT) shall be at least 10 minutes for each vessel with a minimum of two vessels in series (lead/lag) for a total of 20 minutes. Number of trains and capacities shall be determined by system demand and type. DWGWPD must explicitly approve a modified design that includes a proposed EBCT less than a total of 20 minutes.

Current industry standards for effective PFAS removal with GAC is 8-12 minutes of EBCT, the length of time the water has contact with the media. An EBCT shorter than the standard can not only impede treatment effectiveness but also may reduce the longevity of the filter media. GAC filters are typically designed with at least two trains of parallel or lead-lag configuration, with both trains suited to meet maximum daily demand individually. GAC is typically effective for a variety of influent water quality conditions. However, the filter media is susceptible to fouling over time, which can increase headloss or cause premature breakthrough. For this reason, pretreatment with bag or cartridge filters is often recommended. Additionally, GAC filtration should be placed upstream of chlorination when possible and if not, dechlorination will likely be required prior to GAC treatment.

In emergency situations or with treatment intended for short-term use, the filter technology selected is often that which is most readily available, which is typically GAC. If possible, emergency or temporary treatment equipment should be designed so as to easily transition to a permanent treatment facility to minimize future capital costs. Oftentimes equipment can be contracted on a rent-to-own basis, reducing upfront costs. If building interior space is limited and equipment must be placed outside, it is necessary to draft a winterization plan to detail temporary heating and housing of the equipment throughout the cold season.

6.5.2 *Anion Exchange (AIX) Resin*

PFAS-selective ion exchange media is a relatively new technology, and thus there are significantly fewer suppliers compared to GAC. Because of this, resin media prices are higher than GAC, and the media may be prone to temporary market scarcity. Resin removes PFAS through adsorption and ion exchange; in this process PFAS adheres to the surface of the filter media. Because resin media has two forms of contaminant removal, resin media bed life is often longer than that of GAC. Media can be manually loaded or educted into filter vessels, and, when the effective media life has been exhausted, it must be removed and disposed of. Refer to **Section 6.9.5** for specific details on waste disposal. Resin media for PFAS applications are anionic: negatively charged PFAS compounds bind to the positively charged media. It is important to note that the PFAS-selective resin media are a new, modified resin technology, and the older, cationic or non-PFAS-selective resin will not provide effective treatment. Resin must be NSF 61 certified for use in drinking water applications.

EBCT for resin treatment shall be at least 5 minutes for each vessel with a minimum of two vessels in series (lead/lag) for a total of 10 minutes. Number of trains and capacities shall be determined by system demand and type. The Secretary must explicitly approve a modified design that includes a proposed EBCT less than a total of 10 minutes.

Because of the dual removal mechanisms used by resin, resin filters require a shorter EBCT than GAC filters to be equally effective. Resin EBCT commonly ranges from 2 to 5 minutes. Compared to GAC, resin systems operate within a narrower range of flow to minimize channelization. If treatment flow rates are anticipated to be highly variable, a design may include many small filters that can be cycled on as demand requires. Alternatively, a storage tank may be warranted to minimize flow variations through the filters. Additionally, resin media is not capable of withstanding oxidants: if residual oxidants (such as chlorine or permanganate) are present in the treatment influent, the resin media will break down. If the resin filter must be downstream of an oxidation point, designs must include an oxidant neutralization step before the AIX filter.

6.5.3 *Membrane Filtration*

Nanofiltration and reverse osmosis membranes use high pressure and physical sieving to remove contaminants in water. Reverse osmosis will remove nearly all influent contaminants, including both molecules and dissolved ions. With PFAS treatment, membrane reject water or waste brine, will have concentrated PFAS that must be treated appropriately and will probably be difficult to dispose of. This reject water is typically run through a GAC vessel to remove the PFAS which helps with transport for offsite destruction. Historically, RO systems have been too expensive and waste too much water to consider for treatment. However recent advances in technology and a more competitive marketplace have resulted in RO filtration being a potentially viable option. Membrane filtration should be considered on a case by case basis and it is important to note any changes in water corrosivity entering the distribution system.

6.6 Likelihood of Achieving a Short or Long-Term Solution

With adequate EBCT, GAC and resin filtration are capable of high PFAS removal rates. To maintain effectiveness over time, PFAS samples should be collected at a minimum on a quarterly basis at the influent, midpoint and effluent locations of a treatment train. On a more frequent basis such as daily or weekly, the system operator should monitor and record the system pressures. Any changes to influent concentrations or general water chemistry may impact filter media performance and lifetime.

6.7 Treatment Technology Comparison

6.7.1 *Water Quality Parameters*

Iron & Manganese Pretreatment

While GAC filter media is considered fairly resilient to fouling in a variety of water chemistry conditions, GAC effectiveness can be inhibited by the presence of chlorine, organics (TOC/Color), or particulate matter in the influent. If chlorine is added upstream of the GAC filter, the system will require a dechlorination step before the filter to prevent adsorption site competition. Additionally, 4-log disinfection will be required after GAC filtration is added to a system. Appropriate CT can be met by having adequate disinfectant residual concentrations for an adequate amount of contact time. On a case-by-case basis, existing UV systems on NTNC systems may be allowed, however there will be a need to introduce chlorine periodically as an operational and maintenance procedure to prevent biofilm growth that may slough off the GAC.

Comparatively, resin filter media effectiveness is very sensitive water quality. Influent water chemistry must be within the target ranges as shown below and any slight deviation from the desired ranges will require pretreatment, so as to not impact the useful life of the media. Additionally, the resin media cannot tolerate any residual oxidant in the water (chlorine, permanganate, etc.). Neutralization of the oxidant must occur upstream of the future resin filter to avoid media degradation. Additionally, 4-log disinfection will be required after GAC filtration is added to a system. Appropriate CT can be met by having adequate disinfectant residual concentrations for an adequate amount of contact time. Chlorine is required for PCWS and chlorine and/or UV may be acceptable for an NTNC system where all water use is within the building (premise plumbing; no buried piping).

Membrane filters are not typically limited in terms of treatability if water chemistry falls within typical groundwater ranges (see table below). Higher levels of TSS or TDS may require more frequent backwashing, resulting in higher O&M costs and reduced membrane life.

It is advised that the PWS, under direction of their professional engineer, collect raw water quality data for pre-screening of parameters that will affect treatment and the need for pretreatment. The following list of parameters are offered for consideration; however, please consult with treatment vendors (see **Appendix B**) for specific testing requirements.

Table 6. Potential Water Quality Testing Parameters for Filtration Technologies

Alkalinity as $CaCO_3$*	Fluoride	Particle Count	Sulfate*
Ammonia	Hydrogen Sulfide	Perchlorate	TDS
Arsenic	Iron (total) **	pH	Temperature
Bromide	Magnesium	Phosphate	TOC*
Chloride*	Manganese (total) **	Potassium	TSS
Chromate	Calcium	SDI (silt density index)	Turbidity
COD	Nitrate	Sodium	Uranium
Colloidal Silica	Nitrite (as N and NO_3)*		VOC
Color			

** indicates a critical data requirement by Purolite PFAS Resin manufacturer*

***Special attention should be paid to in influent iron and manganese is particulate or dissolved are particulate metals can lead to filter fouling.*

Note: This table presents a general list of water quality constituents that may be relevant to design of centralized treatment for removing regulated PFAS. Prior to collecting water quality samples for evaluation of these constituents, the design engineer must evaluate water quality data available for the water system and occurrence of target constituent in public water supplies in Vermont. For example, it would be very uncommon for a Vermont PWS to have a supply source that contains appreciable quantities of colloidal silica.

Table 7. General Water Quality Guidelines for Filtration Technologies

Parameter	Units	GAC	Resin	Membrane
Iron	mg/L	<1	<0.1 - 0.3	< 0.1
Manganese	mg/L	<0.5	<0.05	< 0.05
pH	--	5 - 9	4 - 10	--
Langelier Index		< 0	--	--
Chloride	mg/L	<500	<100	--
Ammonia	mg/L	--	<1	--
Nitrate/Nitrite	mg/L	--	<10 each	--
Free/Total Chlorine	mg/L	absent	absent	< 0.1
Total Organic Carbon (TOC)	mg/L	<1	<1 - 10	< 2
Total Suspended Solids (TSS)	mg/L	<2 – 3		
Turbidity	NTU	<1	<0.75	< 0.5
Silt Density Index	--	--	--	3
Particulate Size	microns	< 5 - 25	< 5 - 25	< 5
Oil & Grease	mg/L	< 0.1	< 0.1	< 0.1

Source: Calgon Carbon, ECT2, AdEdge, American Membrane Technology Assoc., Pure Aqua., Veolia

6.8 PFAS Treatment Technologies Costs and Lead Times

6.8.1 *PFAS Treatment Technologies*

Table 8 shows the estimated range of costs for GAC, Resin, and Membrane without any additional pretreatment requirements. The table also includes typical costs for annual operation & maintenance and replacement costs. A list of treatment vendors that provided information for this document are included in **Appendix B.**

Table 8. Costs and Lead Times for PFAS Treatment Technologies

Flow (gpm)	Filtration Technology	Costs for Equipment, Installation, Startup & Engineering in Existing Space	Costs for Equipment, Installation, Startup & Engineering with New Building	Equipment Lead Time	Costs for Annual O&M	Costs for Equipment Replacement
5	GAC	$15,000 to $20,000	$40,000 to $45,000	2 to 6 weeks	$10,000 to $15,000	$7,000 to $13,000
	Resin	$15,000 to $20,000	$40,000 to $45,000	2 to 6 weeks	$10,000 to $15,000	$7,000 to $13,000
	Membrane	$30,000 to $40,000	$60,000 to $70,000	2 to 3 months	$15,000 to $20,000*	$20,000 to $30,000
10	GAC	$20,000 to $30,000	$50,000 to $60,000	2 to 6 weeks	$15,000 to $20,000	$14,000 to $20,000
	Resin	$20,000 to $30,000	$50,000 to $60,000	2 to 6 weeks	$15,000 to $20,000	$14,000 to $20,000
	Membrane	--	$75,000 to $90,000	2 to 3 months	$20,000 to $25,000*	$25,000 to $45,000
20	GAC	---	$125,000 to $175,000	1 to 2 months	$20,000 to $25,000	$60,000 to $120,000
	Resin	---	$125,000 to $175,000	1 to 2 months	$20,000 to $25,000	$60,000 to $120,000
	Membrane	---	$125,000 to $150,000	3 to 4 months	$30,000 to $40,000*	$50,000 to $75,000
50	GAC	---	$175,000 to $250,000	2 to 3 months	$30,000 to $35,000	$100,000 to $150,000
	Resin	---	$175,000 to $250,000	2 to 3 months	$30,000 to $35,000	$100,000 to $150,000
	Membrane	---	$225,000 to $275,000	4 to 5 months	$60,000 to $90,000*	$130,000 to $160,000

** Does not include treatment and disposal of reject water which will be concentrated with PFAS and other constituents.*

The following notes apply to the above table of costs and lead times.

Equipment Notes:

- For smaller and larger systems GAC and resin costs are fairly comparable, followed by membrane filtration being the highest.
- Due to the size and space requirements of equipment for systems over 20 gpm it is assumed that those systems will require new building space to accommodate the equipment.

O&M Notes:

- O&M cost above include:
  - operation and maintenance of the PFAS filtration technology and particulate pretreatment.
  - quarterly sampling for PFAS for treatment influent, midpoint, effluent plus a blank.
  - annual treatment media replacement and disposal
- Membrane costs do not include reject water treatment or disposal. Costs of handling reject water varies significantly with water quality and quantity and will have concentrated levels of PFAS.
- Piloting of different filtration technologies on the PFAS impacted water can yield important information for estimated annual costs. O&M costs will be largely tied to the frequency of the filter media replacement, maintenance, any pretreatment if required, added electricity usage from pumping against a higher head, waste disposal, sampling collection, analysis and reporting. We advise the PWS and their professional engineer to collect raw water quality data for pre-screening parameters listed in the previous section. Once this actual site data is collected and provided to vendors, then treatment alternatives can be evaluated and ranked based on anticipated performance, pretreatment requirement and costs.
- See **Table 9** for estimated pretreatment costs.

Replacement Cost Notes:

- Replacement costs above includes replacement and labor costs of the new equipment in kind, and costs are in 2019 dollars.

6.9 Technical Requirements

6.9.1 *Backwashing and Pretreatment Requirements*

With GAC, backwash rates are typically 1.5 times the influent rate and should typically last 15-30 minutes. Backwashing a GAC filter designed for PFAS removal is not preferred as this process fluidizes the GAC bed, disrupting the mass transfer zone and mobilizing contaminants throughout the filter. This makes it difficult to track PFAS breakthrough. Resin media has a specific gravity similar to water. Backwash rates must be kept relatively low to ensure proper bed expansion. Thus, any backwashing of resin filters has limited improvements on headloss conditions as solids are not readily removed. Backwashing should be performed with PFAS-free water when possible. To accommodate this, a storage tank for treated water may be necessary to ensure an adequate supply of water is available for a filter backwash.

Traditionally, nanofiltration and RO membranes required extensive backwashing volumes to maintain filter performance, with backwash volumes approaching 30-50% of the total treated volume of water produced. However, recent technologies have demonstrated successful backwashing while significantly reducing backwash volumes. RO backwashing is an automated process and backwash initiation can be configured for a specified setpoint (e.g. headloss or salinity). RO backwash waste brine tends to become highly concentrated with PFAS. To dispose of the brine, the reject water is often passed through a GAC filter with EBCTs in the range of several hours in a process called superloading. Effluent from the superloader can be disposed of as traditional wastewater, and GAC can be sent to a reactivation facility when exhausted.

Pretreatment can improve PFAS removal effectiveness by eliminating competition and increasing filter media life. Common types of pretreatment in Vermont include particulate removal, iron and manganese removal, and softening. Particulate treatment removes silt and particulate metals that may prematurely foul or clog downstream PFAS filters. Treatment is typically comprised of cartridge or bag filtration with openings of 5 or 10 microns however small sand filters may also be used. Iron and manganese treatment is designed to remove the metals before they have a chance to precipitate and foul the PFAS filters. Treatment is often with an oxidation/filtration method, however other types of filter media are available. Softening is designed to remove water hardness (calcium and magnesium) that can shorten the run time of membrane filters. Softening uses ion exchange resin to exchange calcium and magnesium ions for smaller sodium ions.

When using GAC, particulate pretreatment is often recommended to improve performance but when using a resin, some form of solids removal is always required before resin filtration to protect the resin from fouling. In general, pretreatment requirements for membrane filtration will likely be determined based on concentrations of suspended solids, iron, and manganese and the langelier saturation index (LSI) of the water to be treated. Pretreatment filters (greensand, cartridge, etc.) do not remove PFAS, however residual PFAS may been present on used filter media and should be disposed of properly. Should dissolved iron or manganese be present in the raw water, the water system should consider sequestering prior to PFAS treatment. Sequestering should be discussed with the filter supplier to ensure compatibility. **Table 9** shows the estimated additional costs if water quality determines that pretreatment is required to increase the effectiveness of the PFAS removal systems. Costs and lead times below are shown for particulate removal, iron & manganese removal, and softening at four flow rates. Potentially required pretreatment systems are not limited to the technologies shown in **Table 9**. A list of treatment vendors that provided information for this document are included in **Appendix B.**

Table 9. Costs and Lead Times for Pretreatment Technologies

Flow (gpm)	Pretreatment Technology	Costs for Equipment, Installation, Startup & Engineering in Existing Space	Costs for Equipment, Installation, Startup & Engineering with Added Building Space	Approximate Equipment Lead Time	Range of Costs for Annual O&M
5	Solids	$3,000 to $4,000	$10,000 to $12,000	2 to 4 weeks	$1,000 to $2,000
	Iron/Manganese	$8,000 to $10,000	$15,000 to $20,000	2 to 4 weeks	$8,000 to $12,000
	Hardness	$4,000 to $6,000	$12,000 to $15,000	2 to 4 weeks	$5,000 to $7,000
10	Solids	$4,000 to $6,000	$15,000 to $17,000	2 to 6 weeks	$2,000 to $3,000
	Iron/Manganese	$10,000 to $12,000	$20,000 to $25,000	2 to 6 weeks	$14,000 to $17,000
	Hardness	$8,000 to $10,000	$15,000 to $20,000	2 to 6 weeks	$10,000 to $12,000
20	Solids	---	$20,000 to $25,000	4 to 6 weeks	$3,000 to $4,000
	Iron/Manganese	---	$30,000 to $35,000	4 to 6 weeks	$25,000 to $30,000
	Hardness	---	$25,000 to $30,000	4 to 6 weeks	$16,000 to $18,000
50	Solids	---	$35,000 to $50,000	1 to 2 months	$5,000 to $10,000
	Iron/Manganese	---	$50,000 to $60,000	1 to 2 months	$40,000 to $50,000
	Hardness	---	$45,000 to $55,000	1 to 2 months	$20,000 to $30,000

** O&M costs do not include treatment and disposal of backwash water which will be concentrated with PFAS and other constituents.*

6.9.2 *Space Requirements*

In general, GAC filters require a larger footprint than resin filters due to the higher EBCT required. Membrane systems can be designed for the smallest footprint of all technologies; however, membrane system sizes vary most often depending on pretreatment requirements and on cleaning and post-treatment chemical requirements.

6.9.3 *Operation & Maintenance Considerations*

Both GAC and resin filters require minimal operation and maintenance. GAC must be backwashed to reduce headloss across the bed and intermittently changed out as specified above. GAC media changeouts require removal of spent media by replacement with a new media vessel or by hand shoveling, vacuuming, or educting old media out of the existing vessel. New media is installed by hand loading or eduction. Spent media will be disposed of as specified in **Section 6.9.5**. New filter media requires an initial backwashing to remove "fines", small particles of carbon dust, and a period of filtering to waste to verify water is in compliance with all water quality standards, including pH. Resin media changeouts are similar to GAC in media removal and new installation; new resin media must also be backwashed and filtered to waste. Depending on system pH requirements, additional backwashing or flushing may be necessary. Virgin GAC and new resin initially alter the pH of the filtered water but will eventually stabilize. Membrane systems require the most operation and maintenance to maximize the longevity of the filter membranes. Typical backwashing and membrane cleaning systems are mounted with the membrane skid.

6.9.4 *Monitoring and Reporting*

Periodic sampling must be performed for GAC and resin filters and should include mid-bed sample taps if available in the filter vessel. Mid-bed samples allow for better tracking of PFAS progression through the media. If mid-bed sampling is impossible, such as with smaller filters, GAC or resin should be operated in a lead-lag configuration with a sample point between the two filters. This setup allows the lead vessel to be more completely used before media replacement.

Additional sampling and monitoring equipment should include logging of filter differential pressure to monitor headloss across the filter media. Significant headloss can cause damage to the filter media; backwashing or even media replacement may be necessary. When using resin filtration, it is recommended that operators collect effluent nitrate and chloride samples. With reverse osmosis filtration, the corrosivity of the filtered water may require adjustment to better align with corrosivity of the current water. Collection of distribution system lead and copper samples, as well as other general corrosion parameters, is recommended to verify there has been no impacts on distribution system health.

6.9.5 *Waste Disposal – PFAS Treatment Systems*

Spent GAC can be reactivated in a process that burns the GAC at a high temperature. The temperature in the reactivation facility is high enough to destroy the adsorbed contaminants but not high enough to destroy the GAC. The carbon remaining can be reused for non-drinking water purposes. Spent resin must be destroyed. The resin is burned in an incinerator or cement kiln which breaks down both the contaminants and the resin polymer beads. It's important to note that the temperature required to destroy PFAS is higher than normal incinerators operate at. High temperature incineration is required. Currently, no material known to contain PFAS can be landfilled in Vermont, but out-of-state landfills may operate differently.

6.10 60% Schematic Design for a 10 gpm PFAS Treatment System

An example PFAS treatment system designed to treat 10 gpm and have a pretreatment system for iron and manganese removal is included in **Appendix C**. This example design has 3 sheets that include Notes and Legend, a Process Flow Diagram and a Floor Plan.

Sheet 1: Notes and Legend
This sheet provides general system notes, permits, PFAS treatment system notes, pretreatment system notes and a legend.

Sheet 2: Process Flow Diagram
This sheet shows a typical treatment design schematic for a PFAS removal system assuming the system demand is 10 gpm. The example show is for a PCWS that provides PFAS treatment with GAC or AIX resin using two trains of lead/lag vessel. The pretreatment is an oxidation/filtration system with the addition of chlorine as an oxidant. Following pretreatment, a GAC filter is used to dechlorinate the pretreatment effluent prior to PFAS treatment. Following PFAS treatment post chlorination is used for disinfection.

When designing a PFAS removal system the PWS and their engineer should consider the notes on all three sheets and the Water Quality Parameters (**Section 6.7.1**), which discuss several considerations that could greatly affect the types of treatment equipment necessary and the sizing of the systems. The schematic is intended to be a guideline and should be used in conjunction with a professional engineer to create a complete system design.

Sheet 3: Floor Plan
This sheet shows a typical floor plan for a PFAS removal system, assuming a 12- foot by 15-foot space. The equipment arrangement and size will depend on the PWS's existing treatment equipment, existing building space, and water quality data. The footprint shown assumes the 10 gpm system footprint for a CWS given the existing pumping system has the capacity to provide flow through all additional treatment vessels and still meet system demand. Proper consideration should be given to building space requirements for operation, maintenance, media replacement and the potential for future expansion that satisfy WSR and building code compliance.

A list of vendors that were contacted during the preparation of this Response Plan is included in **Appendix B**, however, they are not to be considered as preapproved or endorsed. Treatment equipment may require testing for parameters (see **Tables 6** and **7**) that are not included in routine sampling, verify with treatment vendors.

7.0POTENTIAL SOURCES OF FUNDING

Response actions will require unplanned expenditures. Costs of regulatory compliance is the responsibility of the PWS. Upon a PWS receiving notice from the DWGWPD for the first sample with PFAS greater than 20 ng/L, the DWGWPD will request that the PWS begin evaluating funding mechanisms for improvements. The WMPD may also require the RP to provide funding for drinking water and/or treatment. As part of contacting funding agencies, the PWS should also contact their own insurance company as soon as possible. The PWS should start their Alternatives Analysis with their engineer as soon as they are notified to distribute "Do Not Drink" notices. PWS potential sources of funding may include:

Table 10. Potential Sources of Funding

Funding Source	Contact Information	Applicable for
Drinking Water State Revolving Fund (DWSRF)	Celia Riechel DWSRF Program Lead and Water Infrastructure Sponsorship Program (WISPr) 802-585-4904 Celia.Riechel@vermont.gov	Municipal PWSs & certain privately-owned PWSs
US Rural Development (USDA)	Eric Law VT Community Programs Director 802-828-6033 Eric.law@usda.gov	Municipalities or Municipal PWSs Emergency Community Water Assistance Grants (ECWAG) could be available for
Vermont Economic Development Authority (VEDA)	Eun-Young Denny 802-828-5020 edenny@veda.org	Private Schools, Private entities, Condo Associations, Businesses, etc..
Commercial Bank Loan	Contact local banking institutions	All PWSs
Vermont Municipal Bond Bank (VMBB)	Ashley Lucht 802-654-7377 Ashley@vtbondagency.org	Municipal PWSs
Reliance on capital reserves	PWS Financial Personnel	Systems with available reserves
Insurance and/or Responsible Party (RP)	To be determined by the PWSs insurance company and RP determination by the WMPD	PWSs whose insurance company deems the PFAS Response actions coverable and/or where an outside RP is identified by the WMPD.

8.0REGULATORY CONTACTS

Table 11. Regulatory Contacts

Name	Affiliation	Title	Phone / Email
Bryan Redmond	DWGWPD	Division Director	802-585-4900 bryan.redmond@vermont.gov
Ellen Parr-Doering	DWGWPD	Deputy Division Director	802-236-1483 ellen.parrdoering@vermont .gov
Tim Raymond	DWGWPD	Engineering and Operations Section Chief	802-371-7614 tim.raymond@vermont.gov
Patrick Smart	DWGWPD	Engineering Section Supervisor	802-461-5661 patrick.smart@vermont.gov
Ben Montross	DWGWPD	Chief of Compliance and Support Services	802-498-8981 benmontross@vermont.gov
Jeff Girard	DWGWPD	Compliance & Certification Manager	802-585-0314 jeff.girard@vermont.gov
Charles Schwer	WMPD	Division Director	802-249-5324 chuck.schwer@vermont.gov
Eamon Twohig	WMPD	Program Manager (emerging contaminants program)	802-490-6189 eamon.twohig@vermont.gov
Patricia Coppolino	WMPD	Environmental Program Manager	802-249-5822 patricia.coppolino@vermont.gov
Matt Moran	WMPD	Environmental Program Manager	802-522-5729 matt.moran@vermont.gov

9.0ADDITIONAL INFORMATION

Vermont Department of Environmental Conservation

- Vermont PFAS Investigation and Response
  https://dec.vermont.gov/pfas

- PFAS Document Library
  https://anrweb.vt.gov/DEC/_DEC/PFASDocs.aspx

- PFAS Data
  https://dec.vermont.gov/water/drinking-water/water-quality-monitoring/pfas

- Water Supply Rule – Effective 04/12/19
  https://dec.vermont.gov/sites/dec/files/dwgwp/DW/Water-Supply-Rule-April-12-2019.pdf

- Water Supply Rule - Proposed
  https://dec.vermont.gov/sites/dec/files/dwgwp/wqmonitoring/pdf/Water-Supply-Rule-Clean.pdf

- Investigation and Remediation of Contaminated Properties Rule (I-Rule)
  https://dec.vermont.gov/sites/dec/files/wmp/Sites/0706.IRule_.pdf

Vermont Department of Health

- Perfluoroalkyl and polyfluoroalkyl substances (PFAS) in Drinking Water
  https://www.healthvermont.gov/environment/drinking-water/perfluoroalkyl-and-polyfluoroalkyl-substances-pfas-drinking-water

Vermont Rural Water Association
http://www.vtruralwater.org/

Interstate Technology Regulatory Council (ITRC)
https://pfas-1.itrcweb.org/fact-sheets/

US Environmental Protection Agency (EPA)
https://www.epa.gov/pfas

APPENDIX A

Example Notice of Alleged Violation

Vermont Department of Environmental Conservation
Drinking Water and Groundwater Protection Division
One National Life Drive - Main 2 [phone] 802-828-1535
Montpelier, VT 05620-3521 [fax] 802-828-1541
http://dec.vermont.gov/water

Agency of Natural Resources

[OWNER NAME]
[OWNER ADDRESS 1]
[OWNER ADDRESS 2]
[OWNER CITY, STATE, ZIP]

December 20, 2019

CERTIFIED MAIL

NOTICE OF ALLEGED VIOLATION

Dear [OWNER NAME]:

The Agency of Natural Resources alleges that you have exceeded a drinking water standard of Act 21: *An act relating to the regulation of polyfluoroalkyl substances in drinking and surface waters*. Specifically, our records indicate you exceeded the interim drinking water standard of 20 parts per trillion (ppt) for per- and polyfluoroalkyl substances (PFAS) at [WATER SYSTEM NAME], [WATER SYSTEM ID NUMBER].

The average of the results of the initial and confirmation PFAS samples were [XX] ppt.

Compliance Directives:

1. **Within 24 hours** of being notified of the exceedance, follow the instructions to complete and issue the enclosed Do Not Drink public notice to all users of the water system;

2. **Within 10 days** of the date you issue the public notice, complete the certification section of the public notice document and send a copy of the issued public notice to the Drinking Water and Groundwater Protection Division;

3. **Within 7 days** of this notice, engage with a professional engineer who will:
   a) Coordinate an onsite meeting with project managers from both the Drinking Water and Groundwater Protection and Waste Management Divisions of the Department of Environmental Conservation to review the water system, including supply sources;
   b) Evaluate short-term alternatives to providing safe drinking water for the protection of public health, as well as alternatives for interim and long-term remediation and conformance with Legislative Act 21 interim drinking water standard and Vermont Water Supply Rule, Chapter 21; and
   c) Establish a date by which a technical proposal will be provided to the to the Drinking water and Groundwater Protection Division for consideration and approval.

Per Section 2(e) of Act 21, the Secretary (of Natural Resources) may enforce the requirements of this section under 10 V.S.A. chapter 201. In response to the alleged violations, the Agency may issue a Civil Complaint pursuant of 10 V.S.A. Section 8019 which would assess a penalty. The Agency may also issue an Administrative Order pursuant to 10 V.S.A. Section 8008 which would require full compliance with all applicable statutes, rules, and/or permits; assess penalties; and if necessary, require corrective/restorative action and any other measures deemed appropriate. Prompt correction of the alleged violations may lessen the possibility or severity of any enforcement action taken by the Agency.

If you have any questions about this alleged violation or need information on how to comply, please contact Jeff Girard at 802-585-0314.

Sincerely,

Emily Boedecker, Commissioner
Department of Environmental Conservation

By: ____

Ben Montross, Compliance and Support Services Section Chief
Drinking Water and Groundwater Protection Division

Enclosures
Do Not Drink Public Notice Template and Certification

cc: Ben Montross, Compliance and Support Services Section Chief DWGWP
Tim Raymond, Engineering and Operations Section Chief, DWGWP
Jeff Girard, Compliance and Certification Manager DWGWP
Pat Smart, Engineering Section Supervisor, DWGWP
Janelle Wilbur, Compliance Analyst DWGWP
Dana Nagy, Operations Section Supervisor, DWGWP
[CONTACT], Site Manager, WMPD
Sarah Vose, State Toxicologist
Lori Cragin, Vermont Department of Health
[CONTACT], Town Health Officer
[CONTACT], Designated Operator
[CONTACT], Administrative Contact
WSID File [WATER SYSTEM ID NUMBER]

PUBLIC NOTICE
IMPORTANT INFORMATION ABOUT YOUR DRINKING WATER

Do Not Drink the Water at [WATER SYSTEM NAME]
Levels of PFAS above state drinking water standards

The standard for the combination of five PFAS: PFOA (perfluorooctanoic acid), PFOS (perfluorooctane sulfonic acid), PFHxS (perfluorohexane sulfonic acid), PFHpA (perfluoroheptanoic acid) and PFNA (perfluorononanoic acid) is 20 parts per trillion (ppt). That means the sum of the five PFAS levels must not exceed 20 ppt in your drinking water. As required under Act 21 (S.49) enacted in 2019 by the State of Vermont, water quality samples were collected from the [WATER SYSTEM NAME]Water System WSID# [WATER SYSTEM ID NUMBER] on [DATE(S)] and indicate that water being served contains PFAS above the drinking water standard. The average of the combined level of the 5 regulated PFAS is [XX] ppt.

As water system users, you have a right to know what you should do, what this means, and what is being done to correct this situation. Due to the potential for impact to human health, the Vermont Department of Environmental Conservation (DEC) has required the Water System to provide this Do Not Drink notice to all users of the water system.

This **DO NOT DRINK NOTICE** remains in effect until further notice.

What should I do?

- DO NOT DRINK THE WATER. Do NOT use the water for drinking or cooking, brushing teeth, making ice cubes, making baby formula, washing fruits and vegetables, or any other consumptive use.
- Use another source of water for consumption which may include bottled water.
- Water may be used for other uses when you don't swallow the water, such as showering, bathing, or washing clothes or dishes. Try to limit the amount of water children swallow while bathing.
- Do NOT use water containing the five PFAS over 20 ppt to water your garden. The PFAS could be taken up by the vegetables.
- DO NOT BOIL THE WATER. Boiling the water will not remove PFAS and may concentrate them.
- If you have specific health concerns, contact your health care professional.

What does this mean?

PFAS is a group of chemicals that may affect different systems in the body. Although more research is needed, some studies in people have shown that these chemicals may affect growth, learning, and behavior in babies and children; lower a woman's chance of getting pregnant; interfere with the body's natural hormones; increase cholesterol levels; affect the immune system; and increase the risk of cancer. These health effects may be the same for pets. If you are concerned, you can give your pet bottled water or water from a known safe source.

What happened? What is being done?

____

____

For questions about the health effects of PFAS visit www.healthvermont.gov/water/pfas or call 211.

Additional information is also available at https://dec.vermont.gov/water/drinking-water/water-quality-monitoring/pfas.

For more information from the water system, please contact [WATER SYSTEM CONTACT] at [PHONE NUMBER], or via email at [EMAIL].

Please share this information with all the other people who drink this water, especially those who may not have received this notice directly (for example, people in apartments, nursing homes, schools, and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.

CERTIFICATION

Method(s) of Distribution: ________________________________ Date Distributed: _________________

(e.g. hand or direct delivery, posting[1], television, radio)

I ____________________________________(print name) Certify, as the Responsible Person (or authorized representative) of the water system listed above that this public notice has been provided to customers in accordance with the delivery, content, and format requirements and deadlines in the Vermont Water Supply Rule (Chapter 21, Subchapter 21-10).

Signature: ____ Date: ___________________

Within 10 days of issuance of public notice, send a copy of the notice to:
Drinking Water and Groundwater Protection Division, One National Life Drive – Main 2, Montpelier, VT 05620-3521

1 - Community Water Systems may use posting as a second method, but must also use radio, television, or hand or direct delivery.

APPENDIX B

List of Vendors

Appendix B - Vendor List

Vendor	Location	Contact	Phone	Email	Flow Rates (gpm)				PFAS Treatment Technologies				Pre-Treatment Technologies				
					5	10	20	50	GAC	Resin	Membrane	Other	Particulate	Softening	Iron/Manganese	Chloride	Sulfide
AdEdge Technologies		Greg Gilles		ggilles@adedgetechnologies.com	X	X	X	X		X			X				
Aquarepinc		Brendan		brendan@aquarepinc.com													
Calgon Carbon	Moon Township, PA	Mike Donaway	732-424-2089	mdonaway@calgoncarbon.com			X	X	X								
Clean Harbors Filtration and Treatment Services	Norwell, MA		231-258-8014														
Clear Water Filtration	Waitsfield, VT	Steve Parker	802-496-5518	steve@clearwaterfiltration.com	X	X	X	X	X	X			X	X	X	X	X
Culligan	Colchester, VT	Everett Windover	800-400-0099	windover@culligan4u.com	X	X	X	X	X	X			X	X	X	X	X
David F. Sullivan & Associates (WesTech)	Seabrook, NH	Mike Sullivan	508-878-1016	mikesullivan@davidfsullivan.com	X	X	X	X	X	X	X						
Desalitech/Technology Sales	Newton, MA	Rob Trzepacz	603-848-3950	RobT@techsalesne.com	X	X	X	X			X						
ECT2	Portland, ME	Steve Woodard	207-482-4601	swoodard@ect2.com	X	X	X	X	X	X			X				
Filters Water	Londonderry, NH	Mike T		Miket@filterswater.com	X	X	X	X	X	X			X				
Lakeside Water	Milwaukee, WI	Tim Marek	414-362-0787 ext.33	tmarek@lakesidewater.com													
		Loretta Voge		LVoge@lakesidewater.com													
Marlo-inc		Ben Johnson		bjohnson@marlo-inc.com													
New Terra		Marshal Deane		mdeane@newterra.com													
Onion Equipment Company		Eric Patterson		epatterson@oecprocess.com	X	X	X	X	X	X			X	X	X	X	X
Pall Water		David Glovinsky	516-924-2041	dave_glovinsky@pall.com													
Pure Flow	Peterborough, NH	Todd Somerset	603-924-4008	todd@pure-flow.com	X	X	X	X	X	X			X	X	X	X	X
Purolite	Bala Cynwyd, PA	Joe Klimek	M: 908-328-7426, O: 1-	joe.klimek@purolite.com													
RE Prescott	Exeter, NH	Rowen Prescott	603-772-4321 x44	rowen@represcott.com	X	X	X	X	X	X			X	X	X	X	X
TC Tech	Wayne, NJ	Wayne Gendron	973-476-5098	wayne.gendron@tctechllc.com													
Tetrasolv	Houston, TX	Doug Dallmer	713-703-6516	ddallmer@tetrasolv.com													
Tigg	Oakdale, PA	David Woods	724-704-3020 x106	dwoods@tigg.com	X	X	X	X	X	X	X		X	X	X		
		Karl Kuchling	501-548-5007	kkuchling@tigg.com													
Veolia/Kruger	Cary, NC	Tom Perry	919-653-5084	tom.perry@veolia.com	X	X	X	X	X	X	X		X	X	X	X	X

Appendix B - Emergency Treatment Vendor List

PFAS Response Plan

Vendor	Location	Contact	Phone	Email	Flow Rates (gpm)				PFAS Treatment Technologies				Pre-Treatment Technologies				
					5	10	20	50	GAC	Resin	Membrane	Other	Particulate	Softening	Iron/Manganese	Chloride	Sulfide
AdEdge Technologies		Greg Gilles		ggilles@adedgetechnologies.com	X	X	X	X		X			X				
Culligan	Colchester, VT	Everett Windover	800-400-0099	windover@culligan4u.com	X	X	X	X	X	X			X	X	X	X	X
David F. Sullivan & Associates (WesTech)	Seabrook, NH	Mike Sullivan	508-878-1016	mikesullivan@davidfsullivan.com	X	X	X	X	X	X	X						
Desalitech/Technology Sales	Newton, MA	Rob Trzepacz	603-848-3950	RobT@techsalesne.com	X	X	X	X			X						
ECT2	Portland, ME	Steve Woodard	207-482-4601	swoodard@ect2.com	X	X	X	X	X	X							
Filters Water	Londonderry, NH	Mike T		Miket@filterswater.com	X	X	X	X	X	X							
Onion Equipment Company		Eric Patterson		epatterson@oecprocess.com	X	X	X	X	X	X			X	X	X	X	X
Pure Flow	Peterborough, NH	Todd Somerset	603-924-4008	todd@pure-flow.com	X	X	X	X	X	X			X	X	X	X	X
RE Prescott	Exeter, NH	Rowen Prescott	603-772-4321 x44	rowen@represcott.com	X	X	X	X	X	X			X	X	X	X	X
Tigg	Oakdale, PA	David Woods	724-704-3020 x106	dwoods@tigg.com	X				X	X	X		X	X	X		
		Karl Kuchling	501-548-5007	kkuchling@tigg.com													
Veolia/Kruger	Cary, NC	Tom Perry	919-653-5084	tom.perry@veolia.com	X	X	X	X	X	X	X		X	X	X	X	X

\\wse03.local\WSE\Projects\VT\VTDEC Drinking Water PFAS Response Plan\Vendor Info\[Vendor List 11-1-2019.xlsx]emergency treatment units

APPENDIX C

Schematic Design – 10 GPM

GENERAL NOTES:

1. WATER SYSTEM SHALL WORK WITH THEIR ENGINEER TO DETERMINE IF EXISTING PUMPING SYSTEM IS CAPABLE OF PROVIDING THE NECESSARY PRESSURE & FLOW THROUGH THE REQUIRED TREATMENT VESSELS WHILE ALSO STILL PROVIDING THE NECESSARY PRESSURE & FLOW TO THE DISTRIBUTION SYSTEM.
2. WATER SYSTEM SHALL WORK WITH THEIR ENGINEER AND A QUALIFIED EQUIPMENT VENDOR TO DETERMINE WHAT RAW WATER ANALYTICAL DATA IS NECESSARY TO DETERMINE PRETREATMENT REQUIREMENTS PRIOR TO DESIGNING GAC OR AIX RESIN TREATMENT SYSTEMS.
3. WHERE POSSIBLE, TREATMENT WILL BE DESIGNED TO MEET MAXIMUM DAY DEMAND AND NOT INSTANTANEOUS PEAK. INSTALLATION OF A STORAGE TANK AND BOOSTER PUMP SHOULD BE EVALUATED IF NOT ALREADY PRESENT.
4. NTNC SYSTEMS WITH EXISTING UV DISINFECTION SYSTEMS MAY BE REQUIRED TO PROVIDE CHLORINE DISINFECTION.

PERMITS:

1. A PERMIT TO CONSTRUCT WILL BE REQUIRED FROM THE DRINKING WATER AND GROUNDWATER PROTECTION DIVISION FOR PROPOSED MODIFICATIONS TO A PUBLIC WATER SYSTEM.
2. A CONSTRUCTION PERMIT WILL BE REQUIRED FROM THE VERMONT DEPARTMENT OF PUBLIC SAFETY, DIVISION OF FIRE SAFETY, FOR CONSTRUCTION OF A WATER TREATMENT BUILDING OR BUILDING MODIFICATION.
3. IF REGULATED UNDER AN ACT 250 PERMIT, THE ACT 250 PERMIT WILL BE AMENDED AS APPROPRIATE.
4. AN UNDERGROUND INJECTION CONTROL PERMIT WILL BE REQUIRED FOR ON-SITE DISPOSAL OF BACKWASH WATER IF WATER QUALITY IS DEEMED ACCEPTABLE.
5. ALL PLUMBING AND ELECTRICAL WORK SHALL BE PERFORMED BY A VERMONT LICENSED PLUMBER AND ELECTRICIAN. PERMITS SHALL BE OBTAINED WHERE APPLICABLE.
6. LOCAL ZONING DEPARTMENT SHALL BE CONTACTED TO INQUIRE IF A PERMIT IS NEEDED.
7. A PERMIT REVIEW SHEET SHALL BE SUBMITTED TO THE STATE PERMIT SPECIALIST.

PFAS TREATMENT SYSTEM NOTES:

GENERAL:

1. GAC & AIX RESIN SYSTEMS REQUIRE TWO FILTERS IN SERIES (LEAD/LAG) TO ENSURE A FACTOR OF SAFETY FOR PFAS REMOVAL. CWS SYSTEMS WILL USE TWO TRAINS OF LEAD / LAG PFAS FILTERS. ONE TRAIN OPERATES AT A TIME. NTNC SYSTEMS WILL USE ONE TRAIN WITH LEAD / LAG PFAS FILTERS.
2. EBCT IS TO BE 10 MIN PER VESSEL FOR GAC (20 MIN PER TRAIN) AND 5 MIN PER VESSEL (10 MIN PER TRAIN) FOR AIX RESIN UNLESS OTHERWISE JUSTIFIED AND APPROVED.
3. WHEN NEW GAC OR AIX RESIN MEDIA IS BROUGHT ONLINE INITIAL FLOW SHOULD BE SENT TO WASTE TO SET THE MEDIA BEDS (SEE BACKWASHING NOTES).
4. WATER SYSTEM SHALL CONSIDER THE NUMBER OF SETS OF LEAD/LAG VESSELS REQUIRED BASED ON SYSTEM TYPE (CWS OR NTNC). AS WELL AS ON SYSTEM MINIMUM AND MAXIMUM FLOW RATES.
5. WHEN TREATMENT MEDIA IS NO LONGER USABLE IT WILL NEED TO BE PROPERLY DISPOSED OF IN ACCORDANCE WITH STATE AND FEDERAL REGULATIONS.

PARTICULATE FILTRATION:

1. IT IS RECOMMENDED BY MOST GAC AND AIX RESIN EQUIPMENT VENDORS THAT PARTICULATE FILTERS BE INSTALLED UPSTREAM. WHEN PARTICULATE FILTERS BECOME SPENT THEY WILL NEED TO BE PROPERLY DISPOSED OF IN ACCORDANCE WITH STATE AND FEDERAL REGULATIONS.

BACKWASHING:

1. PFAS GAC OR AIX RESIN TREATMENT FILTERS TYPICALLY DO NOT REQUIRE BACKWASHING ONCE IN SERVICE MODE. BACKWASHING IS TYPICALLY DONE PRIOR TO COMMISSIONING NEW TREATMENT VESSELS.
2. IF THERE IS NO SUITABLE PUMPING SYSTEM ON SITE TO PROVIDE THE BACKWASH WATER VOLUME AND FLOW RATE, BACKWASHING IS TYPICALLY ACCOMPLISHED BY USING POTABLE WATER FROM A STATE-APPROVED WATER HAULER COMPANY THAT ALSO HAS A PUMPING SYSTEM.
3. THE INITIAL MEDIA BACKWASH SUPPLY WATER SHOULD BE PFAS FREE.
4. BACKWASH WASTE WATER MAY NEED TO BE TEMPORARILY STORED AND TESTED TO DETERMINE PROPER DISPOSAL OPTIONS (TYPICALLY PH AND ARSENIC). PENDING WATER QUALITY RESULTS, WATER MAY REQUIRE OFF-SITE DISPOSAL OR MAY BE ACCEPTABLE FOR ON-SITE DISCHARGE TO THE GROUND SURFACE FOR INFILTRATION. IF DISPOSED OF TO THE GROUND SURFACE VERIFY THAT WATER IS DECHLORINATED AND REGULATED PFAS BELOW APPLICABLE STANDARDS BEFORE DISCHARGING.

PRETREATMENT SYSTEM NOTES:

GENERAL:

1. PRETREATMENT SHOWN INCLUDES PARTICULATE, IRON AND MANGANESE REMOVAL.
2. REQUIRED PRETREATMENT TO BE DETERMINED BASED ON RAW WATER QUALITY DATA AND GAC OR IX RESIN FILTER REQUIREMENTS.
3. MULTIPLE FORMS OF PRETREATMENT MAY BE REQUIRED.
4. TYPICAL TYPES OF PRETREATMENT TECHNOLOGIES INCLUDES BUT ARE NOT LIMITED TO: PH, MANGANESE, IRON, CALCIUM, HYDROGEN SULFIDE AND COLOR.
5. WATER SYSTEM SHALL CONSIDER THE NUMBER OF TREATMENT UNITS REQUIRED BASED ON SYSTEM TYPE (CWS OR NTNC) AS WELL AS SYSTEM MINIMUM AND MAXIMUM FLOW RATES.
6. PROCESS FLOW DIAGRAMS DEPICTED ON SHEET 2 ARE CONCEPTUAL AND TO BE USED AS GENERAL GUIDANCE WHEN REVIEWING ALTERNATIVES.
7. DECHLORINATION AFTER PRETREATMENT IS MANDATORY WITH PFAS IX RESIN TREATMENT AND RECOMMENDED FOR PFAS GAC TREATMENT. DECHLORINATION MAY USE EITHER CHEMICAL FEED SYSTEM OR GAC.
8. CHEMICAL FEED SYSTEMS WILL INCLUDE A SOLUTION TANK, IN-TANK AGITATOR/MIXER, CHEMICAL FEED PUMP, IN-LINE STATIC MIXER AND SUITABLE LENGTH OF PROCESS PIPE OR REACTION TANK TO COMPLETE DECHLORINATION PRIOR TO PFAS TREATMENT MEDIA.
9. WHEN PRETREATMENT MEDIA IS NO LONGER USABLE, MEDIA WILL NEED TO BE PROPERLY DISPOSED OF IN ACCORDANCE WITH STATE AND FEDERAL REGULATIONS.

BACKWASHING:

1. PRETREATMENT SYSTEMS TYPICALLY REQUIRE BACKWASHING AS THEY ACCUMULATE WASTE WITHIN THE FILTER.
2. THE BACKWASH FREQUENCY IS DEPENDENT ON THE RAW WATER QUALITY, FLOW RATE AND PRETREATMENT MEDIA. TYPICALLY BACKWASHING CAN OCCUR ANYWHERE BETWEEN DAILY TO WEEKLY WHEN PRETREATMENT IS REQUIRED.
3. BACKWASHES ARE REQUIRED TO AVOID CLOGGING THE MEDIA AND REDUCING FLOW. PRETREATMENT FILTERS CAN OPERATE AUTOMATICALLY ON DIFFERENTIAL PRESSURE MEASUREMENT, VOLUMETRIC FLOW, TIMED FLOW OR MANUALLY.
4. BACKWASH SYSTEMS OFTEN REQUIRE HIGHER FLOW RATES THAN TYPICAL SYSTEM FLOW. IF ADEQUATE FLOW CANNOT BE MET BY EXISTING SYSTEM PUMP CAPACITY AND STORED PFAS-FREE WATER, THEN A DEDICATED BACKWASH SUPPLY TANK AND PUMP MAY BE NECESSARY.
5. BACKWASH FLOW RATES TO FLUIDIZE THE MEDIA BED MAY REQUIRE A DEDICATED BACKWASH PUMP WITH A HIGHER FLOW RATE THAN THE SERVICE PUMP.
6. BACKWASH VOLUMES FOR A 10 GPM SYSTEM MAY BE A FEW HUNDRED GALLONS USED PER VESSEL PER BACKWASH.

BACKWASH SUPPLY OPTIONS:

1. BACKWASH SHOULD BE PERFORMED USING TREATED WATER.
2. SOURCES OF BACKWASH WATER MAY USE POTABLE WATER FROM AN ON-SITE WATER STORAGE TANK, TREATED WATER FROM A DEDICATED BACKWASH TANK OR POTABLE WATER FROM A STATE-APPROVED WATER HAULING COMPANY.

BACKWASH WASTE CHARACTERIZATION:

1. BACKWASH WASTE FROM PRETREATMENT WILL INCLUDE THE CONTAMINANTS REMOVED BY THE PRETREATMENT SYSTEM THAT MAY ALSO CONTAIN PFAS.
2. WATER SYSTEM AND ENGINEER WILL PROVIDE WATER QUALITY TESTING, INCLUDING PFAS, TO PRETREATMENT EQUIPMENT VENDORS TO ESTIMATE THE ANTICIPATED WASTE CHARACTERISTICS, VOLUMES GENERATED AND DISPOSAL COSTS. INCLUDE ANY OTHER TESTING ANTICIPATED FOR EVALUATING EITHER ON-SITE OF OFF-SITE DISPOSAL.

BACKWASH WASTE DISPOSAL OPTIONS:

1. ON-SITE DISPOSAL: CONTACT VTDEC UNDERGROUND INJECTION CONTROL PROGRAM FOR FURTHER CONSIDERATION OF THE FEASIBILITY OF THIS OPTION.
2. SANITARY SEWER TO WASTE WATER TREATMENT FACILITY: WATER SYSTEM NEEDS TO CONFIRM THAT SANITARY SYSTEM WILL ACCEPT WASTE CONTAMINATED WITH PFAS IF APPLICABLE.
3. ON-SITE TIGHT TANK: WATER SYSTEM MAY STORE BACKWASH WASTE ON SITE AND HAVE IT HAULED TO A WASTE WATER TREATMENT FACILITY OR OTHER APPLICABLE FACILITY THAT WILL ACCEPT THE WASTE.

LEGEND:

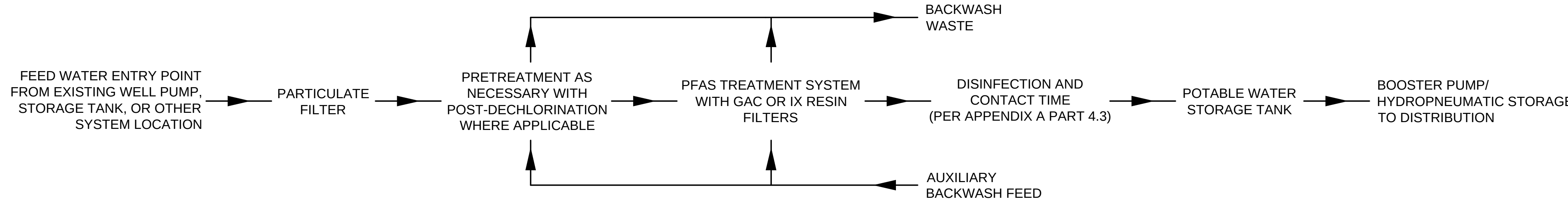
- THREADED UNION
- BALL VALVE (TRUE UNION)
- 3/4" HOSE BIB DRAIN VALVE
- SAMPLE PORT (SMOOTH NOSED)
- CHECK VALVE
- SURGE RELIEF VALVE
- AIR/VACUUM RELEASE VALVE
- MOTORIZED ACTUATED VALVE
- PUMP
- STATIC INLINE MIXER
- FLOW METER
- FLOW RESTRICTOR
- CARTRIDGE/BAG FILTER (IF NECESSARY BASED ON WATER QUALITY DATA)
- CAP / PLUG / CAM LOK FITTING
- INTERLOCKING CONTROL

AIX	ANION EXCHANGE (RESIN FOR PFAS TREATMENT)
AV	ACTUATED VALVE
CF	CARTRIDGE FILTER
CIX	CATION EXCHANGE RESIN (RESIN FOR IRON / MANGANESE PRETREATMENT)
EBCT	EMPTY BED CONTACT TIME
FM	FLOW METER
FS	FLOW SWITCH
GAC	GRANULAR ACTIVATED CARBON
HT	HYDROPNEUMATIC TANK
IX	ION EXCHANGE
NO	NORMALLY OPEN
NC	NORMALLY CLOSED
PI	PRESSURE INDICATING GAUGE
PM	CHEMICAL FEED PUMP
PS	PRESSURE SWITCH
PT	PRETREATMENT TANK
RT	REACTION TANK - GAC FOR DECHLORINATION

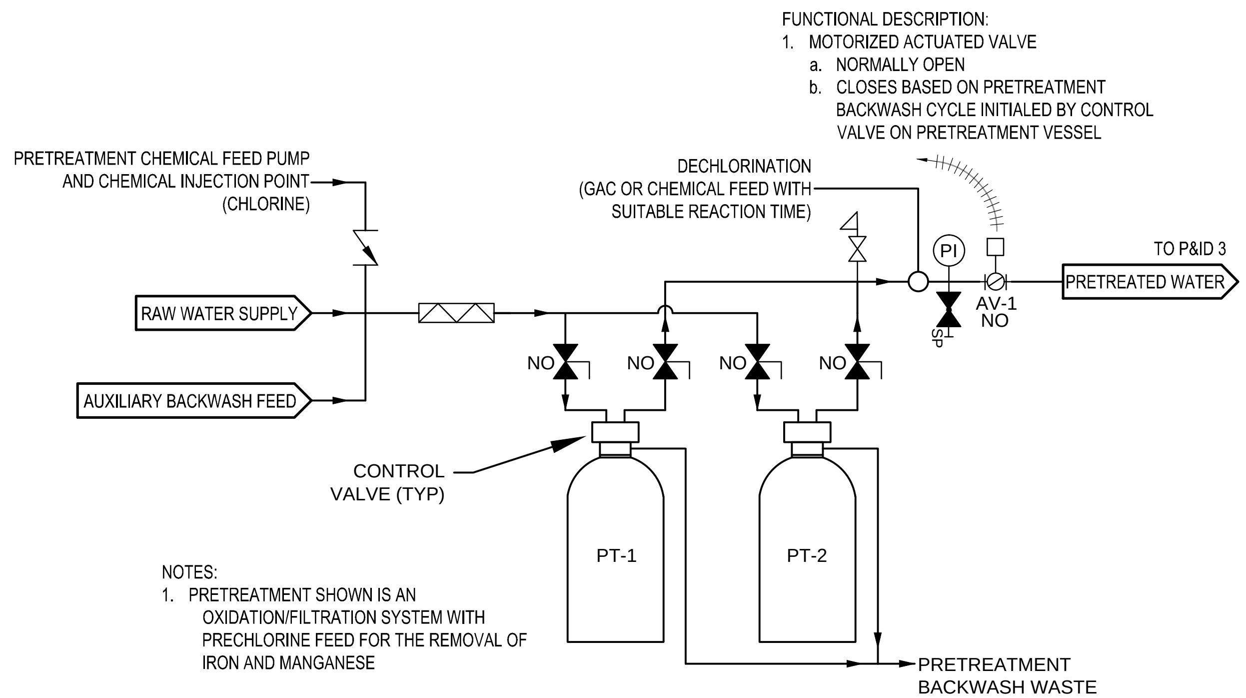
Weston & Sampson

NOT FOR CONSTRUCTION

SHEET 1 OF 3
NOTES AND LEGEND
TYPICAL 10 GPM PFAS REMOVAL SYSTEM
VT DEC - PFAS RESPONSE PLAN

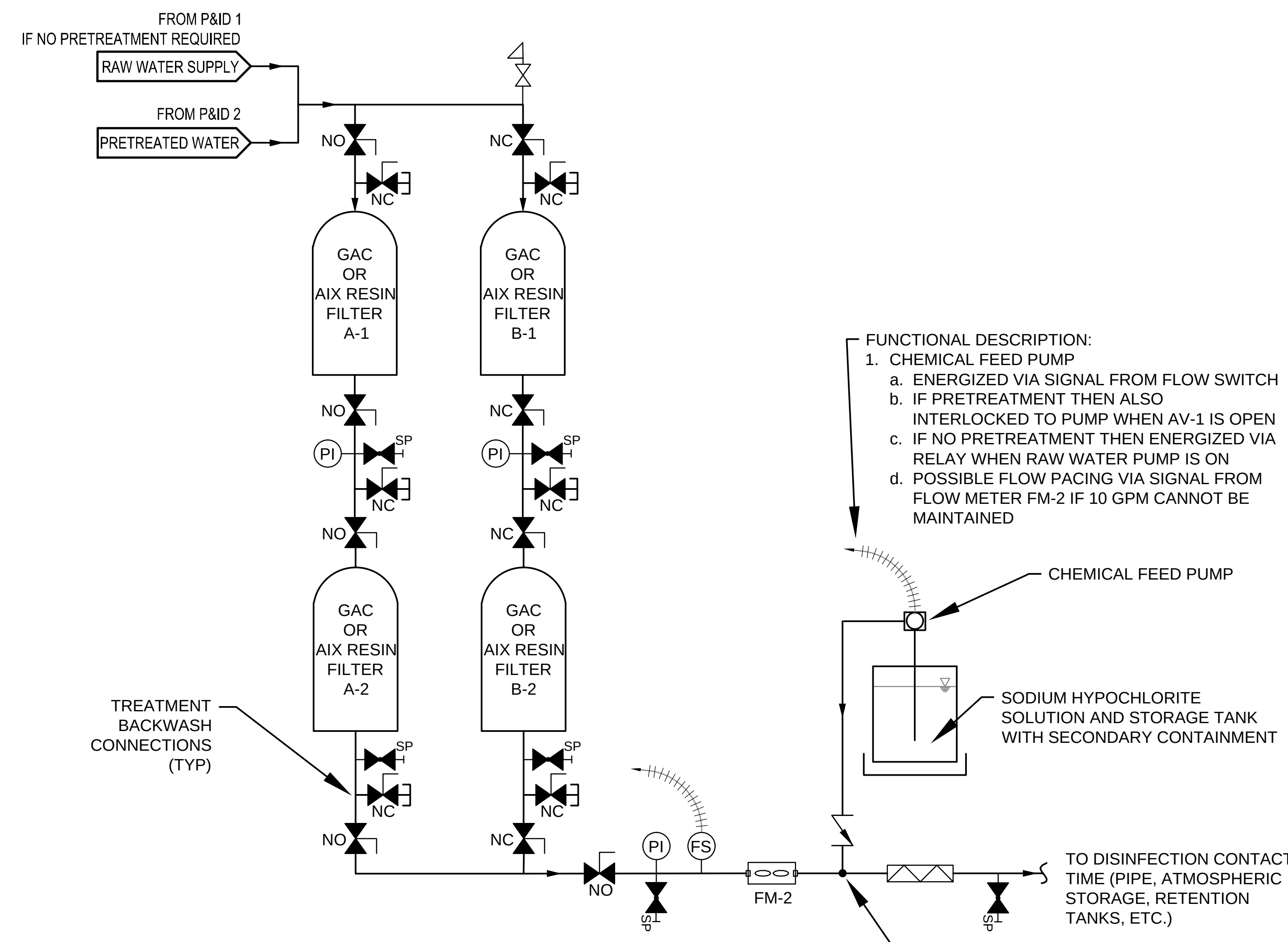


TREATMENT PROCESS FLOW



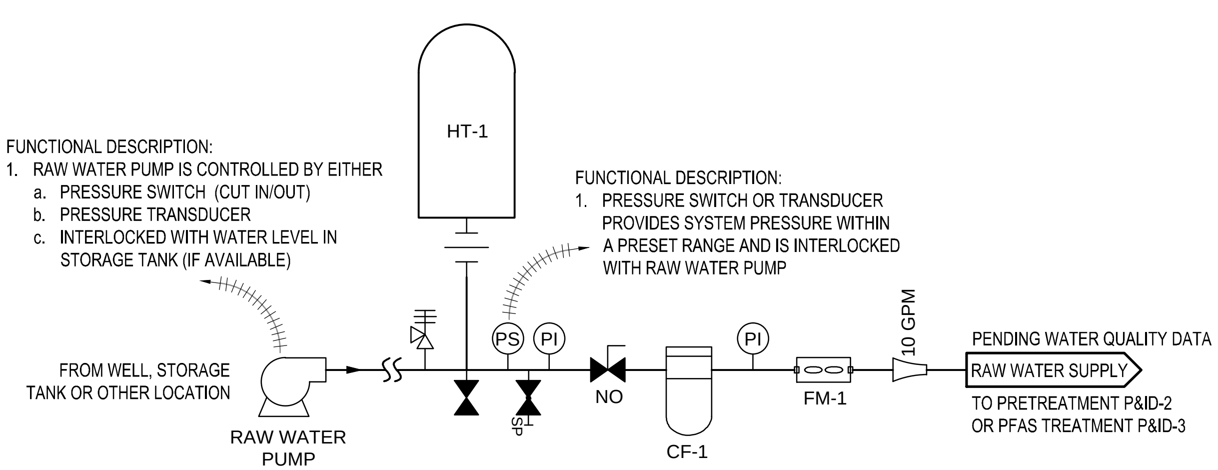
PRETREATMENT SYSTEM (P&ID-2)

SEE PRETREATMENT NOTES ON SHEET 1



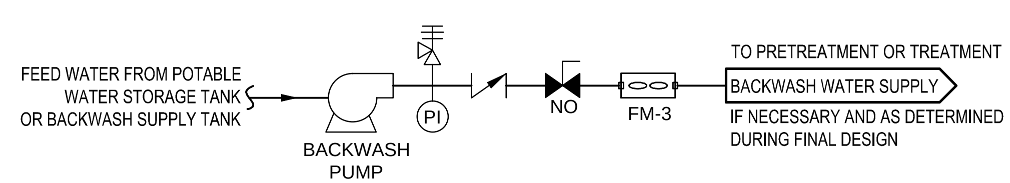
PFAS TREATMENT SYSTEM (P&ID-3)

SEE PFAS TREATMENT NOTES ON SHEET 1



RAW WATER FEED (P&ID-1)

Weston & Sampson



BACKWASH SUPPLY (P&ID-4)

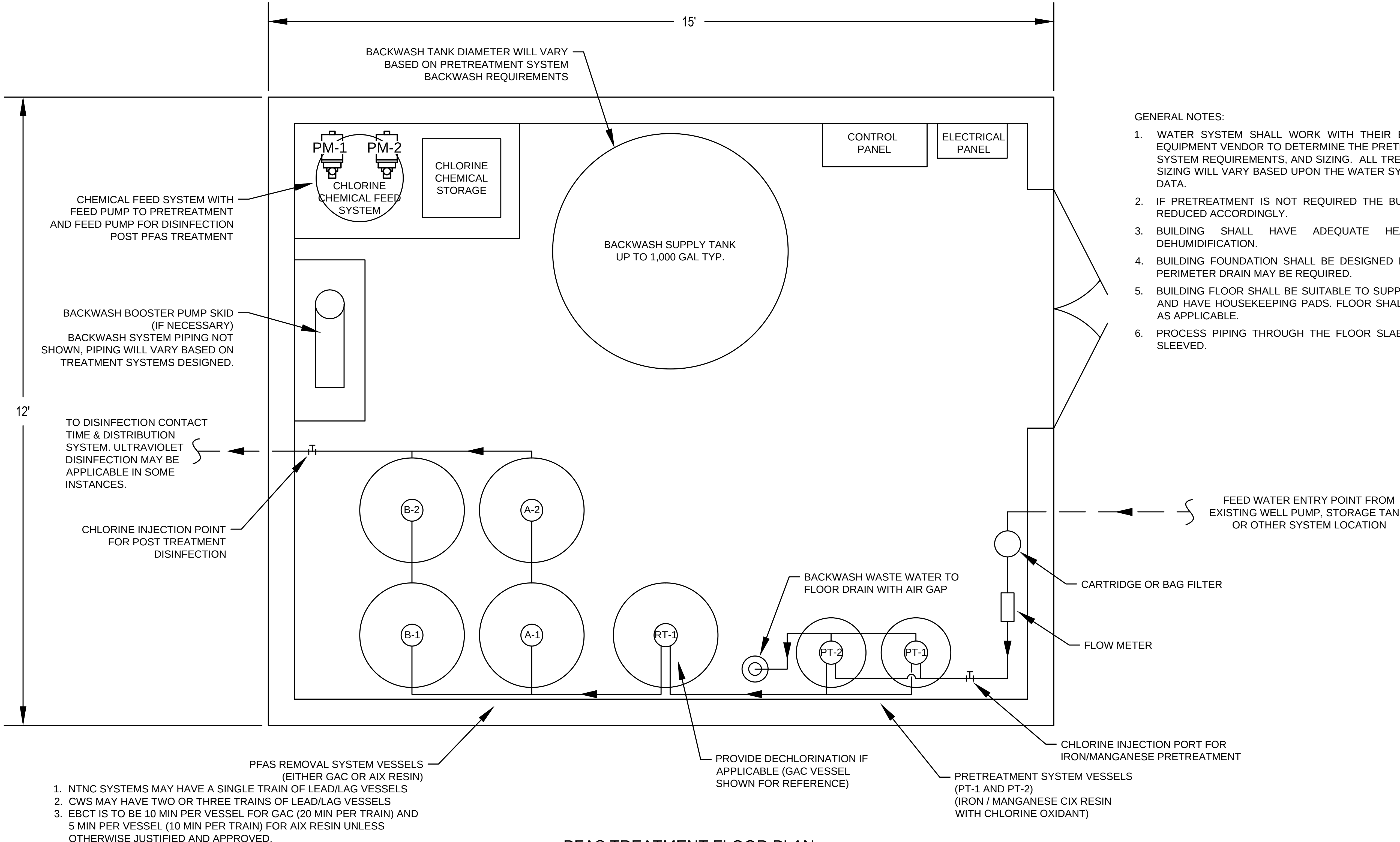
SEE BACKWASH NOTES ON SHEET 1

NOT FOR CONSTRUCTION

SHEET 2 OF 3
PROCESS FLOW DIAGRAM
TYPICAL 10 GPM PFAS REMOVAL SYSTEM
VT DEC - PFAS RESPONSE PLAN

GENERAL NOTES:

1. WATER SYSTEM SHALL WORK WITH THEIR ENGINEER AND A QUALIFIED EQUIPMENT VENDOR TO DETERMINE THE PRETREATMENT, PFAS TREATMENT SYSTEM REQUIREMENTS, AND SIZING. ALL TREATMENT REQUIREMENTS AND SIZING WILL VARY BASED UPON THE WATER SYSTEM'S RAW WATER QUALITY DATA.
2. IF PRETREATMENT IS NOT REQUIRED THE BUILDING FOOT PRINT CAN BE REDUCED ACCORDINGLY.
3. BUILDING SHALL HAVE ADEQUATE HEATING, VENTILATION AND DEHUMIDIFICATION.
4. BUILDING FOUNDATION SHALL BE DESIGNED BASED ON SITE CONDITIONS. PERIMETER DRAIN MAY BE REQUIRED.
5. BUILDING FLOOR SHALL BE SUITABLE TO SUPPORT TREATMENT EQUIPMENT AND HAVE HOUSEKEEPING PADS. FLOOR SHALL SLOPE TO SUMP OR DRAIN AS APPLICABLE.
6. PROCESS PIPING THROUGH THE FLOOR SLAB OR FOUNDATION SHALL BE SLEEVED.



PFAS TREATMENT FLOOR PLAN

2 1 0 2 4

SCALE: 1/2"=1'

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NOT FOR CONSTRUCTION

SHEET 3 OF 3
FLOOR PLAN
TYPICAL 10 GPM PFAS REMOVAL SYSTEM
VT DEC - PFAS RESPONSE PLAN

APPENDIX D

References

APPENDIX D

REFERENCES

1. Act No. 21 An act relating to the regulation of polyfluoroalkyl substances in drinking and surface waters, May 15, 2019
2. Act 21 (S.49): Vermont 2019 PFAS Law Factsheet, July 12, 2019
3. Memorandum of Understanding between the Drink Water and Groundwater Protection Division and the Waste Management and Prevention Division Concerning the State Response to Per- and Polyfluoroalkyl substances (PFAS) Detected in Public Water Supplies, October 14, 2019
4. Water Supply Rule, April 12, 2019
5. VTDEC Perfluoroalkyl Substances (PFAS) Statewide Sampling Plan, June 2019
6. Treatment Technologies for PFAS Site Management, NAVFAC/FRTR, 2018
7. Remediation Technologies and Methods for Per- and Polyfluoroalkyl Substances (PFAS), ITRC, March 2018

ATTACHMENT 1

Act No. 21 An Act Relating to the Regulation of Polyfluoroalkyl substances in Drinking and Surface Waters, May 15, 2019

No. 21. An act relating to the regulation of polyfluoroalkyl substances in drinking and surface waters.

(S.49)

It is hereby enacted by the General Assembly of the State of Vermont:

Sec. 1. FINDINGS

The General Assembly finds that:

(1) Perfluoroalkyl, polyfluoroalkyl substances (PFAS), and other perfluorochemicals are a large group of human-made chemicals that have been used in industry and consumer products worldwide since the 1950s.

(2) PFAS may enter the environment from numerous industrial or commercial sources, including when emitted during a manufacturing process, from the disposal of goods containing PFAS, or from leachate from landfills.

(3) Many PFAS do not readily break down and persist in the environment for a very long time, especially in water, and, consequently, PFAS can be found in many bodies of water and in the blood of humans and wildlife.

(4) The Vermont Department of Health has adopted a health advisory level for certain PFAS of 20 parts per trillion.

(5) The Vermont Water Supply Rule provides that the Secretary of Natural Resources may adopt a Vermont Department of Health advisory level as a maximum contaminant level for a substance.

(6) The Agency of Natural Resources (ANR) has adopted the 20 parts per trillion level as part of ANR's Remediation of Contaminated Properties

Rule and Groundwater Protection Rule and Strategy, but not as part of the Vermont Water Supply Rule or the Vermont Water Quality Standards.

(7) To prevent further contamination of State water, and to reduce the potential harmful effects of PFAS on human health and the environment, the State of Vermont should:

(A) require the Agency of Natural Resources to adopt by rule maximum contaminant level or levels for PFAS under the Vermont Water Supply Rule;

(B) prior to adoption by rule of maximum contaminant level or levels for PFAS, require public water systems to monitor for certain PFAS chemicals and respond appropriately when results indicate levels of PFAS in excess of the Vermont Department of Health advisory level;

(C) require the Agency of Natural Resource to adopt surface water quality standards for certain PFAS chemicals; and

(D) authorize the Agency of Natural Resources to require any permitted facility to monitor for any release of a chemical that exceeds a health advisory issued by the Vermont Department of Health.

Sec. 2. INTERIM DRINKING WATER STANDARD; TESTING; PER AND POLYFLUOROALKYL SUBSTANCES

(a) As used in this section:

(1) "Perfluoroalkyl, polyfluoroalkyl substances" or "PFAS substances" means perfluoroalkyl substances and polyfluoroalkyl substances that are

detectable using standard analytical methods established by the U.S. Environmental Protection Agency, including regulated PFAS contaminants.

(2) "Regulated PFAS contaminants" means perfluorooctanoic acid, perfluorooctane sulfonic acid, perfluorohexane sulfonic acid, perfluorononanoic acid, and perfluoroheptanoic acid.

(b) On or before December 1, 2019, all public community water systems and all nontransient, noncommunity water systems shall conduct monitoring for the maximum number of PFAS substances detectable from standard laboratory methods.

(c) After completion of initial monitoring under subsection (b), a public community water system or a nontransient, noncommunity water system shall conduct continued monitoring for the presence of regulated PFAS contaminants in drinking water supplied by the system as follows until adoption of the rules required under subsection 3(a) of this act:

(1) If initial monitoring results detect the presence of any regulated PFAS contaminants individually or in combination at or above the Vermont Department of Health advisory level of 20 parts per trillion, the public water system shall conduct continued quarterly monitoring.

(2) If initial monitoring results detect the presence of any regulated PFAS contaminants individually or in combination at or above the reporting level of two parts per trillion but below the Vermont Department of Health

advisory level of 20 parts per trillion, the public water system shall conduct continued monitoring annually.

(3) If initial monitoring results detect the presence of any regulated PFAS contaminants below the reporting level of two parts per trillion, the public water system shall conduct continued monitoring every three years.

(d) If monitoring results under subsections (b) or (c) of this section confirm the presence of any regulated PFAS contaminants individually or in combination in excess of the Vermont Department of Health advisory level of 20 parts per trillion, the Agency of Natural Resources shall:

(1) direct the public water system to implement treatment or other remedy to reduce the levels of regulated PFAS contaminants in the drinking water of the public water system below the Vermont Department of Health advisory level; and

(2) direct the public water system to issue a "do not drink" notice to all users of the public water system until the treatment under subdivision (1) of this subsection is completed.

(e) The Secretary may enforce the requirements of this section under 10 V.S.A. chapter 201. A person may appeal the acts or decisions of the Secretary of Natural Resources under this section under 10 V.S.A. chapter 220.

Sec. 3. DEPARTMENT OF ENVIRONMENTAL CONSERVATION WATER SUPPLY RULE; MAXIMUM CONTAMINANT LEVEL FOR PER AND POLYFLUOROALKYL SUBSTANCES;

STANDARD FOR PER AND POLYFLUOROALKYL SUBSTANCES; CLASS OR SUBCLASSES

(a) On or before February 1, 2020, the Secretary of Natural Resources shall file under 3 V.S.A. § 841 a final proposed rule with the Secretary of State and the Legislative Committee on Administrative Rules establishing under the Department of Environmental Conservation's Water Supply Rule a maximum contaminant level (MCL) for perfluorooctanoic acid, perfluorooctane sulfonic acid, perfluorohexane sulfonic acid, perfluorononanoic acid, and perfluoroheptanoic acid. The Secretary shall use the Vermont Department of Health's health advisory level for perfluorooctanoic acid, perfluorooctane sulfonic acid, perfluorohexane sulfonic acid, perfluorononanoic acid, and perfluoroheptanoic acid as the initial basis for developing the MCL under this subsection and may propose adjustments or variances from the advisory level based on scientific evidence, industry standards, or public input.

(b) On or before August 1, 2020, the Secretary of Natural Resources shall initiate a public notice and comment process by publishing an advance notice of proposed rulemaking regarding the regulation under the Department of Environmental Conservation's Water Supply Rule of per and polyfluoroalkyl (PFAS) compounds as a class or subclasses.

(c) On or before March 1, 2021, the Secretary of Natural Resources shall either:

(1) file a proposed rule with the Secretary of State regarding the regulation of PFAS compounds under the Department of Environmental Conservation's Water Supply Rule as a class or subclasses; or

(2) publish a notice of decision not to regulate PFAS compounds as a class or subclasses under the Department of Environmental Conservation's Water Supply Rule that includes, at a minimum, an identification of all legal, technical, or other impediments to regulating PFAS compounds as a class or subclasses and a detailed response to all public comments received.

(d) If the Secretary of Natural Resources proposes a rule pursuant to subsection (c), on or before December 31, 2021, the Secretary of Natural Resources shall file a final rule with the Secretary of State regarding the regulation of PFAS compounds as a class or subclasses under the Department of Environmental Conservation's Water Supply Rule.

Sec. 4. REPEAL; INTERIM DRINKING WATER MONITORING; PFAS CONTAMINANTS

Sec. 2 (interim drinking water monitoring; PFAS contaminants) shall be repealed on the effective date of the rules required under Sec. 3(a) of this act.

Sec. 5. VERMONT WATER QUALITY STANDARDS; PER AND POLYFLUOROALKYL SUBSTANCES

(a) On or before January 15, 2020, the Secretary of Natural Resources shall publish a plan for public review and comment for adoption of surface water quality standards for per and polyfluoroalkyl substances (PFAS) that shall include, at a minimum, a proposal for standards for:

(1) perfluorooctanoic acid; perfluorooctane sulfonic acid; perfluorohexane sulfonic acid; perfluorononanoic acid; and perfluoroheptanoic acid; and

(2) the PFAS class of compounds or subgroups of the PFAS class of compounds.

(b) On or before January 1, 2024, the Secretary of Natural Resources shall file a final rule with the Secretary of State to adopt surface water quality standards for, at a minimum, perfluorooctanoic acid, perfluorooctane sulfonic acid, perfluorohexane sulfonic acid, perfluorononanoic acid, and perfluoroheptanoic acid.

Sec. 6. INVESTIGATION OF POTENTIAL SOURCES OF PER AND POLYFLUOROALKYL SUBSTANCES CONTAMINATION

On or before June 1, 2019, the Secretary of Natural Resources shall publish a plan for public review and comment to complete a statewide investigation of potential sources of per and polyfluoroalkyl substances (PFAS) contamination. As part of this investigation, the Secretary shall conduct a pilot project at public water systems to evaluate PFAS that are not quantified by standard laboratory methods using a total oxidizable precursor assay or other applicable analytical method to evaluate total PFAS. The Secretary of Natural Resources shall initiate implementation of the plan not later than July 1, 2019.

Sec. 7. 3 V.S.A. § 2810 is added to read:

§ 2810. INTERIM ENVIRONMENTAL MEDIA STANDARDS

The Secretary of Natural Resources may require any entity permitted by the Agency of Natural Resources to monitor the operation of a facility, discharge, emission, or release for any constituent for which the Department of Health has established a health advisory. The Secretary may impose conditions on a permitted entity based on the health advisory if the Secretary determines that the operation of the facility, discharge, emission, or release may result in an imminent and substantial endangerment to human health or the natural environment. The authority granted to the Secretary under this section shall last not longer than two years from the date the health advisory was adopted.

Sec. 8. 10 V.S.A. § 8003 is amended to read:

§ 8003. APPLICABILITY

(a) The Secretary may take action under this chapter to enforce the following statutes and rules, permits, assurances, or orders implementing the following statutes, and the Board may take such action with respect to subdivision (10) of this subsection:

* * *

(28) 30 V.S.A. § 255, relating to regional coordination to reduce greenhouse gases; ~~and~~

(29) 10 V.S.A. § 1420, relating to abandoned vessels; and

(30) 3 V.S.A. § 2810, relating to interim environmental media standards.

* * *

Sec. 9. 10 V.S.A. § 8503 is amended to read:

§ 8503. APPLICABILITY

(a) This chapter shall govern all appeals of an act or decision of the Secretary, excluding enforcement actions under chapters 201 and 211 of this title and rulemaking, under the following authorities and under the rules adopted under those authorities:

* * *

(2) 29 V.S.A. chapter 11 (management of lakes and ponds).

(3) 24 V.S.A. chapter 61, subchapter 10 (relating to salvage yards).

(4) 3 V.S.A. § 2810 (interim environmental media standards).

* * *

Sec. 10. ENVIRONMENTAL MEDIA STANDARDS; GUIDANCE; PLAN

(a) On or before January 1, 2020, the Secretary of Natural Resources shall publish a guidance document for public review and comment that sets forth detailed practices for implementation by the Secretary of Natural Resources of interim environmental media standards authority under 3 V.S.A. § 2810.

(b) On or before January 1, 2020, the Secretary of Natural Resources shall publish for public review and comment a plan to collect data for contaminants in drinking water from public community water systems and all nontransient noncommunity water systems for which a health advisory has been established but no maximum contaminant level has been adopted.

Sec. 11. AGENCY OF NATURAL RESOURCES CONTAMINANTS OF EMERGING CONCERN PILOT PROJECT

On or before January 15, 2020, the Agency of Natural Resources shall submit to the House Committees on Natural Resources, Fish, and Wildlife and on Commerce and Economic Development and the Senate Committees on Natural Resources and Energy and on Economic Development, Housing and General Affairs a report regarding the management at landfills of leachate containing contaminants of emerging concern (CECs). The report shall include:

(1) the findings of the leachate treatment evaluation conducted at any landfill in Vermont;

(2) the Agency of Natural Resources' assessment of the results of landfill leachate evaluations; and

(3) the Agency of Natural Resources' recommendations for treatment of CECs in leachate from landfills, including whether the State should establish a pilot project to test methods for testing or managing CECs in landfill leachate.

Sec. 12. EFFECTIVE DATE

This act shall take effect on passage.

Date Governor signed bill: May 15, 2019