GAC Treatment Engineering Checklist for Public Water Systems

This checklist outlines required documentation and important considerations in designing and implementing effective Granular Activated Carbon (GAC) PFAS treatment that aligns with design standards and regulatory requirements outlined in the Vermont Water Supply Rule (Rule). The intent is to streamline and expedite the design and Permit to Construct review process for treatment installation at impacted public water systems exceeding the Maximum Contaminant Level (MCL) for PFAS. Any proposed variances to the Rule shall be accompanied by supporting documentation and a separate Variance Request (Section 3.7 of the Rule). If more space is needed for the responses, please attach additional pages or reference the section/page of the Engineering Report that covers this.

Water System Overview and Treatment Space

1. Provide an overview of the water system and a brief description of proposed construction.

2. Describe the treatment system space and consider operational and maintenance space and any potential impacts to the area. Evaluate if the treatment space is heated and ventilated, not in a confined space, not located within in a flood plain, etc.

3. Describe existing facilities that may impact the proposed treatment design. Consider existing wells, pump stations, treatment facilities, and storage facilities.

4. Proposed treatment equipment will be housed in enclosures that provide adequate room for routine operation and maintenance and protection from weather elements. ☐ Yes ☐ No
5. If new structures are needed to house treatment equipment, please provide a description.

6. If standby power is currently available, is it adequate to run the proposed new infrastructure? ☐ Yes ☐ No ☐ Not Applicable
7. Evaluate existing disinfection treatment infrastructure (if applicable). Provide a discussion of any improvements that are necessary to ensure disinfection treatment will meet requirements of Appendix A, Subpart 4.3 and 40 CFR Part 141.

8. A location map is provided. ☐ Yes ☐ No
9. Water System Permitted Source Capacity:
10. Maximum Daily Demand in gallons per minute (gpm):
11. Instantaneous Peak Demand (gpm):
12. Describe any existing infrastructure that is being removed or modified as part of the proposed project.

13. Describe any other proposed improvements to the water system infrastructure (if applicable) such as new storage and new pumping facilities, etc.

Water Quality Characteristics

1. Characterize the contaminants and their concentrations that the proposed treatment is designed to remove.

2. Characterize water quality constituents and their concentrations that may interfere with GAC treatment. Refer to the PFAS Treatment Engineering Document for more details on interfering water quality constituents.

Water Quality Constituent	Concentrations
Nitrate (milligram per liter; mg/L)	
Nitrite (mg/L)	
Phosphate (mg/L)	
Sulfate (mg/L)	
Bicarbonate (mg/L)	
Chloride (mg/L)	
Iron (mg/L)	
Manganese (mg/L)	
Turbidity (nephelometric turbidity units; NTU)	
pH	
Alkalinity (mg/L)	
Hardness (mg/L)	
Total Organic Carbon (mg/L)	

3. Describe how the water quality constituents can impact carbon media lifespan and whether pretreatment is needed. Refer to the PFAS Treatment Engineering Document for specific water quality constituents.

4. Water quality samples were collected and analyzed in accordance with requirements of Subchapter 21-6. ☐ Yes ☐ No ☐ Unknown
5. Does water quality sampling follow the Rule Appendix A 4.11.1(a)? Describe water sampling locations and when water samples were collected. ☐ Yes ☐ No

GAC Treatment Design Recommendations

1. Non-Community water system: At least one train of two GAC filters are plumbed in series. ☐ Yes ☐ No ☐ Not Applicable
2. Community water system: At least two filter trains are proposed, each train consisting of two GAC filters plumbed in series.
    a. Where only two filter trains are proposed, each train is capable of meeting the plant design capacity (the projected maximum daily demand) at the approved filtration rate. ☐ Yes ☐ No ☐ Not Applicable
    b. Where more than two treatment trains are proposed, the filters are capable of meeting the plant design capacity at the approved flow rate with one treatment train removed from service. ☐ Yes ☐ No ☐ Not Applicable
3. All wetted components are NSF 61 certified. ☐ Yes ☐ No
4. All treatment chemicals are NSF 60 certified. If yes, please list the chemicals in the proposed design. ☐ Yes ☐ No ☐ Not Applicable

5. Provide justification for the choice of selected GAC media considering water quality discussed above. Provide GAC media manufacturer and type (e.g. Calgon Carbon F400, etc.)

6. Filter media meets the AWWA B604, Standard for GAC. ☐ Yes ☐ No
7. Equipment manufacturer's specifications for units, including minimum/maximum operating flow rates, pressures, operating temperatures and other applicable design parameters are provided. ☐ Yes ☐ No
8. Carbon vessel type:
9. Carbon vessel size (cubic ft):
10. Carbon vessel dimensions (inches): diameter height
11. Describe the arrangement of piping and treatment trains, including lateral header and drainpipes installed within units.

12. Select appropriate underdrain type. If other, please explain.

☐ cone underdrain ☐ external ring ☐ other

13. Media depth is at least 30 inches for every filter: ☐ Yes ☐ No
14. Volume of media in each unit (cubic ft):
15. The amount of headspace and underdrain required for backwashing is accounted for when determining total media volume. ☐ Yes ☐ No

16. Provide calculations for the Empty Bed Contact Time (EBCT) for each carbon filter. Calculations should meet or exceed media manufacturer specifications and be based on the actual volume of media in the vessels.

17. EBCT meets the 10-minute minimum assuming maximum flow rate through the primary (lead) vessel(s). If minimum EBCT cannot be achieved, please explain why. Consider the treatment space (e.g., Is building space a limitation?) or other treatment technologies (e.g., smaller footprint of Anion Exchange (AIX)).
☐ Yes ☐ No
18. Provide hydraulic loading rate calculations in gallons per minute per square foot (gpm/ft²) of bed area of each unit. Hydraulic loading rate shall not exceed 7 gpm/ft².

19. GAC filters have necessary piping and valves to facilitate ease of operational adjustments to modify the configuration of primary (lead) and secondary (lag) carbon filters, and to remove filter from service while maintaining functionality of treatment process. If no, please justify. ☐ Yes ☐ No

20. Pressure gauges are proposed so that pressure loss across filter units can be monitored.
☐ Yes ☐ No
21. Provide the range and precision of the pressure gauge including maximum operating pressure. Ensure they are appropriately sized to monitor the pressure loss across the filters per manufacturer specification (must be provided).

22. Include an expected pressure loss across each GAC filter unit.

23. If individual water meters for each well need to be installed as part of the project, they are shown on the Engineering Drawings and cut sheets for the proposed meters are submitted.
    ☐ Yes ☐ No ☐ Not Applicable
24. If new well pumps are proposed, rationales for well pump selection, well pump cut sheets, and well pump operating curves are provided.
    ☐ Yes ☐ No ☐ Not Applicable
25. If more than one source is used, provide details on well pump operation. (i.e., Do well pumps operate at the same time or are they alternating? What is the flow rate for each well?)

26. Disinfection treatment meets requirements of Appendix A Part 4.3 and 40 CFR Part 141.
    ☐ Yes ☐ No
27. Disinfection treatment is provided prior to the entry point to the distribution system.
    ☐ Yes ☐ No
28. Provide appropriate details for the chlorine injection point and any other details associated with disinfection treatment.

29. If proposing post-GAC chlorination, provide chlorine contact time calculations and ensure storage provides adequate chlorine contact time during peak demand.

30. Sample ports are proposed for the inlet and outlet of each unit. ☐ Yes ☐ No
31. Design drawings demonstrate that all sampling ports and gauges are accessible and that the lead/lag changeout can be accomplished. ☐ Yes ☐ No
32. Describe what engineering controls are included in the design to prevent the GAC filters from dewatering.

33. Describe filter to waste and backwash provisions for the GAC filters during startup.

Pretreatment Considerations

1. Water quality constituents that will prevent successful performance of the proposed carbon treatment are present and pretreatment is necessary. (i.e., pretreatment to ensure that iron and manganese concentrations are consistently and reliably less than the Secondary MCL established in Subchapter 21-6 of the Rule). ☐ Yes ☐ No
2. Provide pretreatment rationale and how it can impact water quality and PFAS treatment performance. Consider the treatment processes and sequence of treatment.

3. Treated water below the Vermont PFAS MCL will be used for the backwashing of any pretreatment processes. ☐ Yes ☐ No ☐ Not Applicable

4. Clearly explain the pretreatment backwash and/or regeneration processes.

5. Backflow prevention on the pretreatment backwash line is provided.
☐ Yes ☐ No ☐ Not Applicable
6. Provide the additional demand on booster pumps and well pumps in gpm.

7. Provide total volume of backwash water and the anticipated frequency of backwashing.

8. Describe any negative impacts or limitations to use/demand during backwash/regeneration of pretreatment.

9. Design includes provisions to add a chemical before the carbon treatment if carbon treatment is proposed. ☐ Yes ☐ No ☐ Not Applicable

Operations and Maintenance

1. The Water System has the appropriate Operator Classification for the proposed treatment system. ☐ Yes ☐ No
2. Provide a description of where treatment chemicals will be stored for all chemicals identified in proposed treatment design.

3. Describe how initial backwashing and rinse to waste of the carbon media will be completed upon installation.

4. Provide a description on how the water system will anticipate media change outs. While the best practice for monitoring PFAS breakthrough is sampling at midpoint, it is not currently a requirement. However, relying only on routine compliance sampling may result in an MCL violation and inefficient use of media in a lead/lag filter configuration.

5. Explain how GAC units will be changed out and describe how vessels will be swapped between lead/lag positions.
    a. Consider the size and potential weight of the vessels. Discuss provisions to precondition new carbon media in accordance with manufacturer recommendations.
    b. Consider the requirements for physically moving/removing/replacing treatment vessels and other large equipment and provide details as appropriate to address requirements.
    c. Outline the anticipated lead time required for the vendor (i.e., How many days/weeks lead time are required for them to complete the changeout of the media?).
    d. Demonstrate that the GAC units are not being bypassed.
    e. Describe the anticipated disposal process of the spent GAC media.

6. The Operations and Maintenance Manual or Standard Operating Procedure states that Virgin NSF 61 certified media will be used for all carbon media changeouts (i.e., reconditioned media cannot be used unless pre-approved by the Division).
    ☐ Yes ☐ No
7. The Operations and Maintenance Manual or Standard Operating Procedure will include GAC media start up procedures and include arsenic performance testing.
    ☐ Yes ☐ No
8. Provide the location of where Raw Water samples will be collected.

9. Provide the location of where Entry Point samples will be collected.