Memorandum

To: *Charles Dam, P.E.*

From: *Alan LeBlanc, P.E., BCEE*
Maddison Vidal, P.E.

Date: *April 29, 2024*

Subject: *Manchester-by-the-Sea Gravelly Pond Water Treatment Plant PFAS Treatment Evaluation*
Task 3 – Post-Filter Treatment Executive Summary

At the request of the Town of Manchester-by-the-Sea, Massachusetts (the Town or MBTS), CDM Smith performed an evaluation of post-filter treatment options for per- and polyfluoroalkyl substances (PFAS) that were detected in the Gravelly Pond Water Treatment Plant (GPWTP or WTP) operated by the Department of Public Works (DPW). The goal of this evaluation was to examine post-filter treatment alternatives that could be incorporated into the existing GPWTP treatment processes and improve PFAS compliance for the Town. CDM Smith is pleased to offer this executive summary, which summarizes key findings from the treatment evaluation and recommended next steps.

This work evaluated alternatives and made recommendations for the post-filter treatment of PFAS detected at the GPWTP, to serve as a planning document in preparation for recent PFAS regulatory changes. Infrastructure construction spending would be required to treat the GPWTP water to levels outlined in the proposed regulatory limits. This memorandum includes a desktop evaluation of post-filter PFAS treatment in the form of granular activated carbon (GAC) pressure vessels. Alternatives assessed as part of this work include housing the vessels in the existing garage bay which will require expansion to achieve a limited treatment capacity of 1.5 million-gallon-per-day (mgd), and construction of a building addition to house GAC vessels capable of treating the full GPWTP capacity of 3 mgd. The construction of a new intermediate pump station would be required for either alternative assessed as part of this evaluation.

Introduction

The Town of MBTS has historically remained in full compliance with the Massachusetts Department of Environmental Protection's (MassDEP's) finished water quality maximum contaminant levels (MCLs) for regulated contaminants. The Massachusetts MCL (MMCL), which is 20 nanograms per liter (ng/L), regulates the sum of concentrations of six specific PFAS. The six compounds, termed "PFAS6", include PFOS, PFOA, perfluorohexane sulfonic acid (PFHxS), perfluorononanoic acid (PFNA), perfluoroheptanoic acid (PFHpA), and perfluorodecanoic acid (PFDA). Beginning in 2021, the Town initiated regular sampling of PFAS which has continued periodically, and data was provided through January 2022. The results from preliminary testing have found the regulated PFAS6 concentrations are almost in exceedance of the MMCL at the LSW. Additionally, PFAS6 concentrations are approximately half of the MMCL in the GPWTP finished water. While concentrations have remained below MassDEP's 20 ng/L standard, it is

advisable that MBTS also considers future compliance with PFAS regulations from the United States Environmental Protection Agency (USEPA). On March 14, 2023, EPA released the draft PFAS National Primary Drinking Water Regulation (NPDWR), later finalizing the PFAS NPDWR on April 10, 2024. The current federal standard in effect requires Public Water Systems be in compliance by April 2029.

The USEPA's April 2024 MCLs for both PFOS and PFOA, are set at 4 ng/L while MCLs for PFNA, PFHxS, and hexafluoropropylene oxide (HPFO-DA or GenX) are set at 10 ng/L. Treatment goals outlined in this memorandum were selected out of consideration of these limits. In addition to the MCLs adopted on April 10, 2024, the USEPA's Hazard Index (HI) was formally adopted as a means of regulating a mixture of PFAS chemicals which includes PFNA, PFHxS, GenX, and perfluorobutane sulfonate (PFBS). Based on available data, MBTS is not at risk of exceedance of the HI threshold at GPWTP. However, PFOA and PFOS levels at GPWTP are at risk of exceeding the federal regulations.

Existing Operations

Gravelly Pond and Round Pond Well No. 1 are surface water supplies and the Town's primary water supply source, providing approximately 60 percent of the Town's drinking water. For the purposes of this analysis, it is assumed that the safe yield of Gravelly Pond is equivalent to the GPWTP capacity of 3 mgd. None of the existing systems on site are capable of removing PFAS.

Water Quality

The available data for the regulated PFAS contaminants found in GPWTP samples are plotted in **Figure ES-1**.

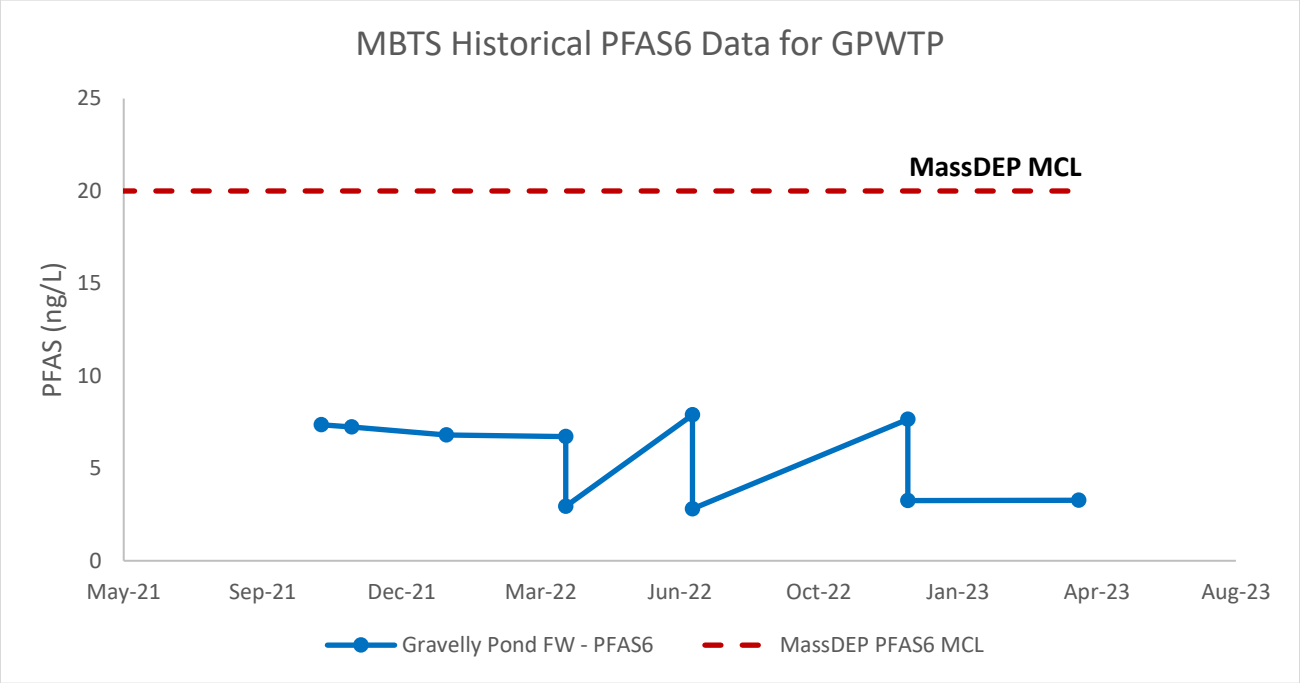


Figure ES-1. GPWTP Historical PFAS6 Data

Prior to further development (bench scale testing, design, permitting, and construction) a full accounting of filtered water quality (i.e., PFAS system influent) should be made. Key parameters include, but are

not limited to, turbidity, pH, alkalinity, Total Organic Carbon, Dissolved Organic Carbon, and free chlorine residual.

Regulatory Requirements and PFAS Treatment Goal

While the current state regulations require less than 20 ng/L in the finished water, a treatment goal of 4 ng/L for PFOS and PFOA was selected out of consideration for the federal regulations. A focus was put on PFOS and PFOA MCLs included in the federal regulation because other individually regulated PFAS (PFNA, PFHxS, and GenX) were appreciably below their respective MCLs. In addition, the PFAS treatment technologies should be able to remove all currently-regulated PFAS to non-detect (2 ng/L) levels during initial operation. However, PFOA and PFOS levels at GPWTP are at risk of exceeding the federal regulations. Bench-scale or pilot testing will better inform the estimated life of the media and effectiveness in removing both regulated and unregulated PFAS.

Treatment Technologies

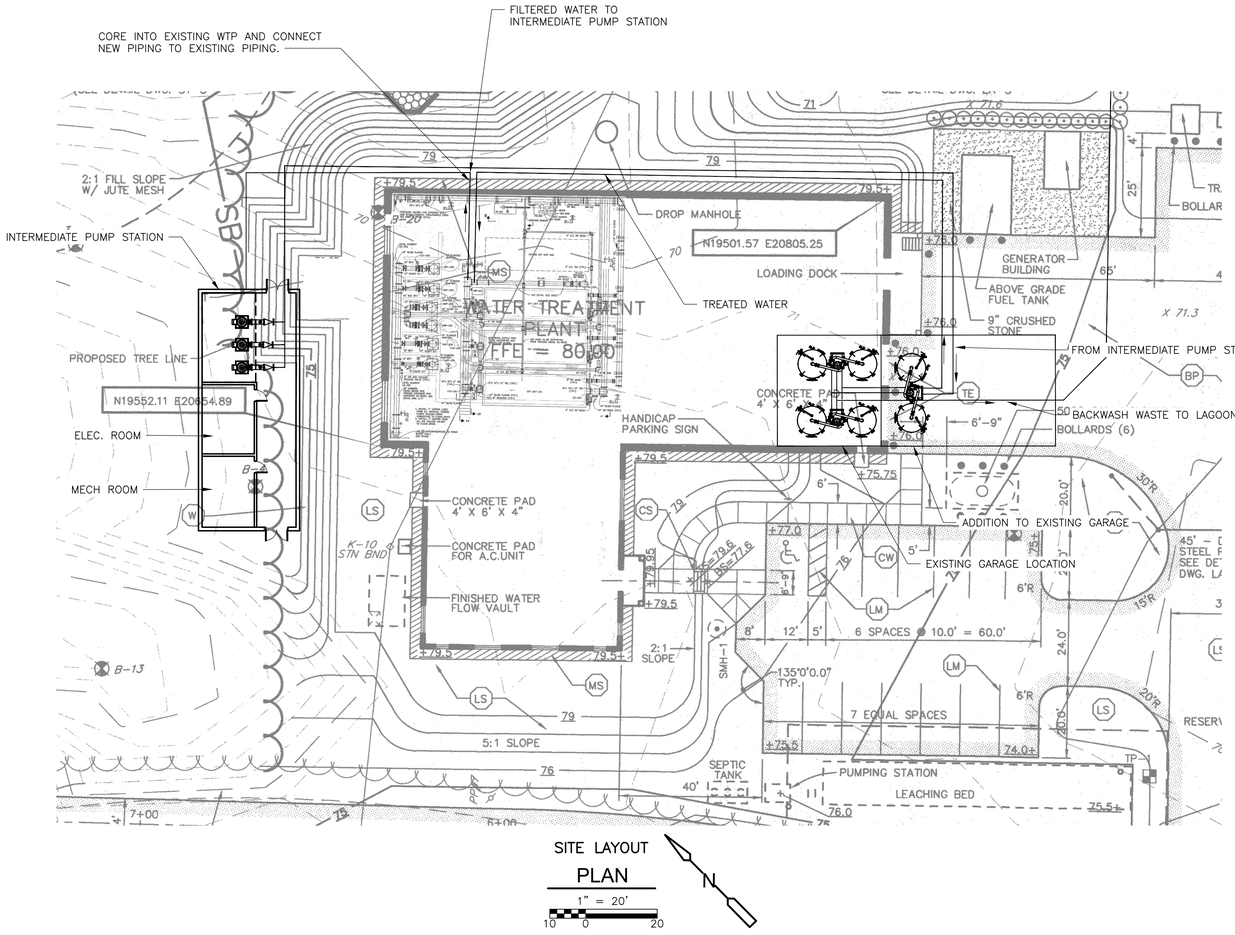
The following treatment technologies for the removal of PFAS were described in the evaluation: granular Activated Carbon (GAC); anion exchange (AIX) and membranes. Although other treatment technologies are included for planning purposes, a focus has been placed on the use of GAC treatment. Granular activated carbon is both a well-proven PFAS treatment technology (especially for long-chain PFAS) and is typically the largest footprint solution, thus representing a conservative basis for planning at this stage of design development.

Preliminary Design Criteria and Cost Estimate

Based on the desktop comparison, the treatment considered for further assessment is post-filter GAC treatment of PFAS with pressure vessels. This evaluation considers placement of GAC treatment downstream of existing filters. Two alternative configurations for post-filter GAC treatment addition were investigated as part of this evaluation:

- Alternative 1 - Addition of new GAC pressure vessels housed in the existing garage bay. Construction of a garage extension and a new intermediate pump station are required. This alternative considers a treatment capacity equal to the current maximum day demand (MDD) in the summer of 1.5 mgd.
- Alternative 2 - Addition of new GAC pressure vessels to be housed in a separate building. This addition will house PFAS treatment and the intermediate pump station. This alternative considers a treatment capacity equal to the GPWTP capacity at 3 mgd.

Post-filter GAC treatment would provide MBTS with a solution to the PFAS concerns associated with the GPWTP and allow for long-term compliance with existing and future regulations. The proposed treatment building for each alternative can be seen in **Figure ES-2** and **ES-3**. Assuming an empty bed contact time (EBCT) of 10 minutes, six, eight-foot diameter GAC vessels are proposed for the 1.5 mgd PFAS removal system for Alternative 1. Assuming the same EBCT of 10 minutes, six, ten-foot diameter GAC vessels are proposed for the 3 mgd PFAS removal system for Alternative 2. The total project cost is estimated to be approximately $13.5 million for Alternative 1 and $16.8 million for Alternative 2, both of which include a 25 percent construction contingency and escalation to the midpoint of construction (assumed in the evaluation to be May 2025). It also includes project contingency and an engineering and implementation allowance.



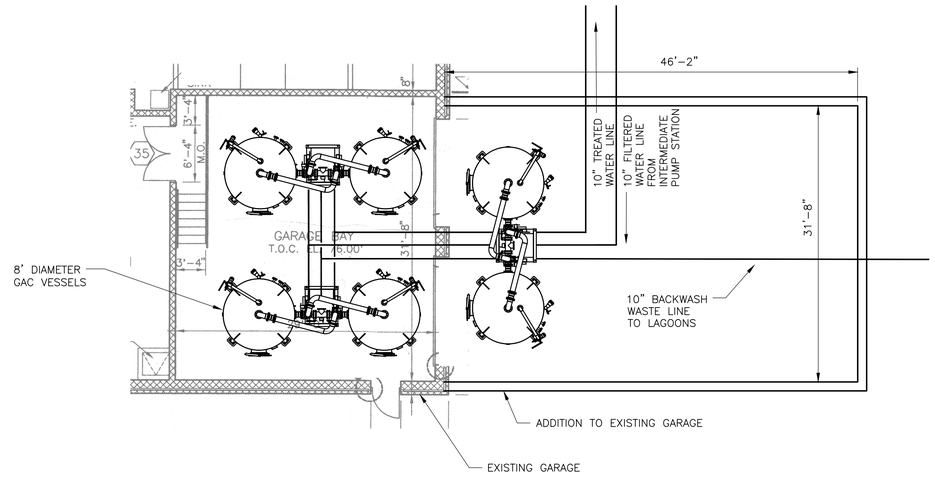
SITE LAYOUT

PLAN

1" = 20'

10 0 20

N

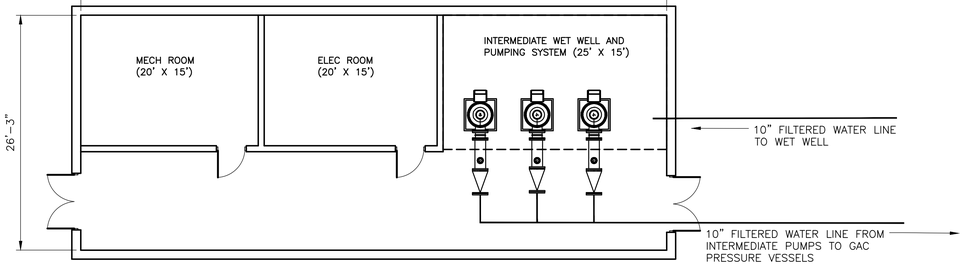


GAC PRESSURE VESSELS IN EXISTING GARAGE WITH ADDITION

PLAN

1/8" = 1'-0"

4 2 0 4 8



INTERMEDIATE PUMP STATION

PLAN

1/8" = 1'-0"

4 2 0 4 8

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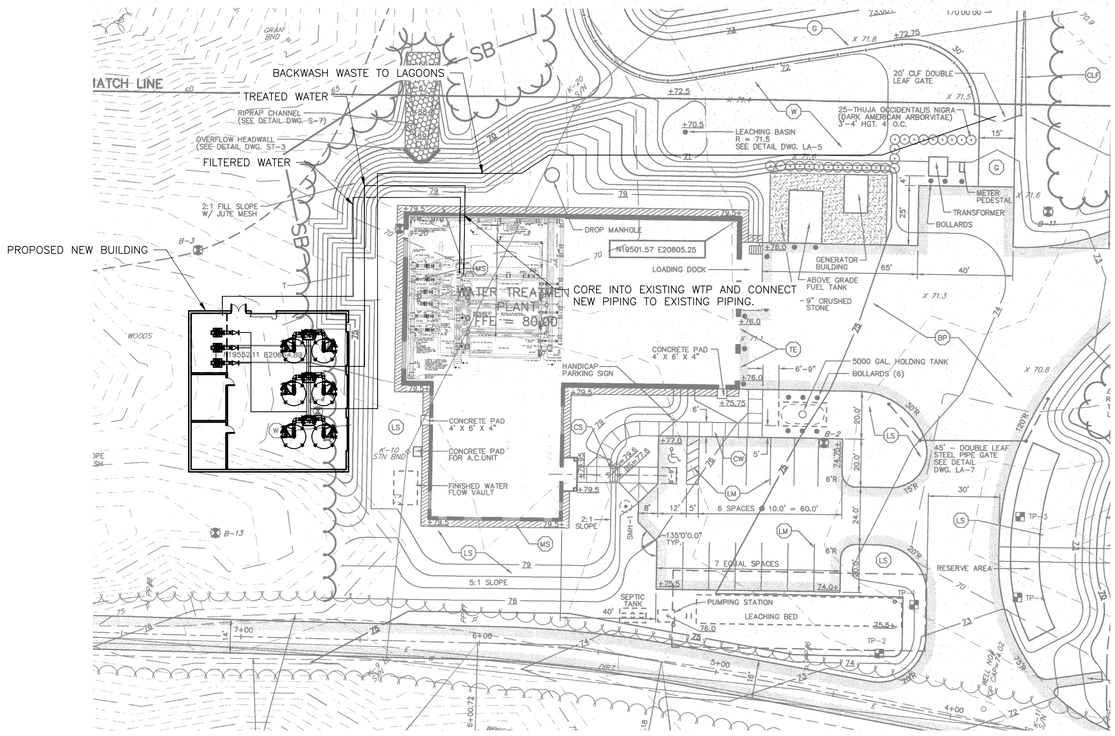
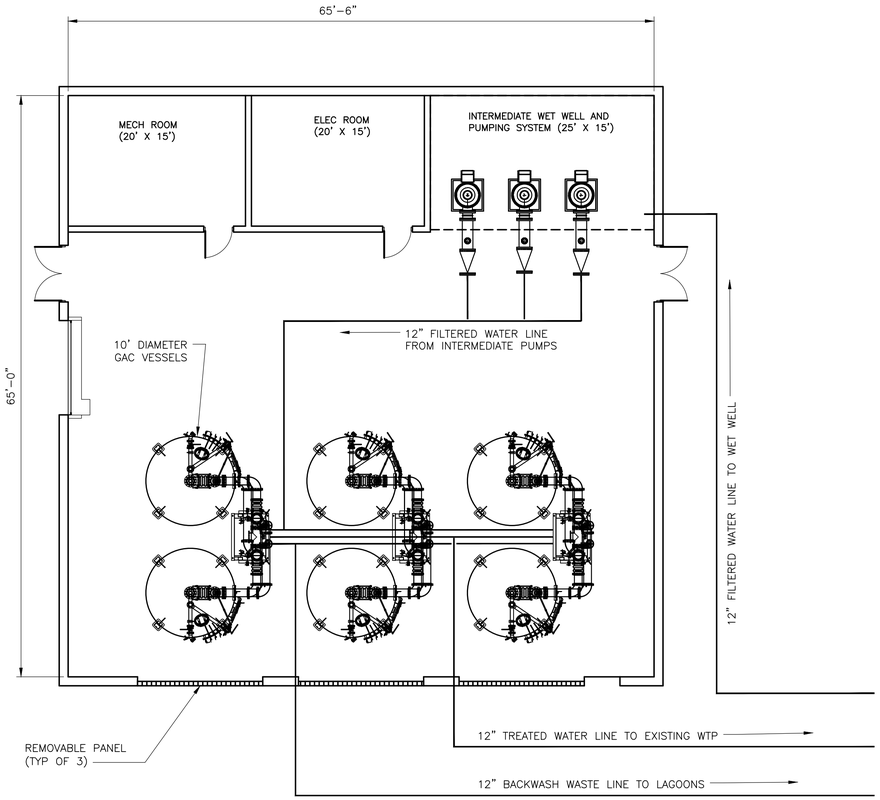
TASK 3 - POST FILTER PFAS TREATMENT

FIGURE ES-2
ALTERNATIVE 1
1.5 MGD INTERMEDIATE PUMPING FACILITY AND PFAS TREATMENT IN EXISTING GARAGE BAY
APRIL 2024



SITE LAYOUT
PLAN
1" = 30'
15 0 30
N



GAC PRESSURE VESSELS IN NEW BUILDING
PLAN
1/8" = 1'-0"
4 2 0 4 8

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TASK 3 - POST FILTER PFAS TREATMENT

FIGURE ES-3
ALTERNATIVE 2
3 MGD INTERMEDIATE PUMPING FACILITY AND PFAS TREATMENT IN BUILDING ADDITION
APRIL 2024

Lincoln Street Wellfield Considerations

The concepts herein could be adapted to treat Gravelly Pond WTP water or GPWTP water mixed with Lincoln Street Well water if it were conveyed directly to GPWTP for treatment. With regard to the existing water treatment processes, the concept of pumping Lincoln Street Well water to the upstream end of the Gravelly Pond WTP process would drive raw water pH downward and would complicate coagulant dosing. Future analysis of blending will determine specific requirements, but at the level of this planning analysis coagulant dosing is not a variable that is likely to add significant cost to WTP operations.

Next Steps for MBTS Consideration and Recommendations

The following next steps are recommended by CDM Smith to advance the design of the PFAS treatment facility:

- Conduct bench-scale and/or pilot testing to confirm treatment efficacy and assess operational costs associated with media changeouts.
- Initiate pre-design task such as surveying, geotechnical investigation, and electrical system verification as these tasks do not rely on the results of bench or pilot testing.
- Develop a detailed project implementation schedule and initiate final design efforts, including required state and local permitting efforts.

cc: Dave Burnett, P.E., PMP, Michaela Bogosh, P.E., PMP, Lisa Gove, P.E. – CDM Smith