PRELIMINARY ENGINEERING REPORT

MANCHESTER WATER TREATMENT IMPROVEMENTS

CONSOLIDATED PFAS TREATMENT

TOWN OF MANCHESTER, MARYLAND

JUNE 2024

GMB JOB NO. 230229

GEORGE, MILES & BUHR, LLC

ARCHITECTS/ENGINEERS

954 RIDGEBROOK ROAD
SUITE 230
SPARKS, MD 21152
410.329.5005

SALISBURY/BALTIMORE/SEAFORD

Manchester Water Treatment Improvements

Consolidated PFAS Treatment

GMB Job No. 230229

Town of Manchester, Maryland

PRELIMINARY ENGINEERING REPORT

TABLE OF CONTENTS

List of Exhibits

List of Appendices

EXECUTIVE SUMMARY

This Preliminary Engineering Report was undertaken by George, Miles & Buhr for the Town of Manchester to evaluate options for centralized PFAS treatment for five (5) existing wells in the Town of Manchester that have PFOS/PFOA concentrations which exceed the EPA's recently proposed Maximum Contaminant Level (MCL) of 4 parts per trillion (ppt). This report provides recommendations to provide a long-term solution to elevated PFAS concentrations by treating the raw water from the existing wells prior to entering the Town's water distribution system.

Based upon the investigations and evaluations contained in this Preliminary Engineering Report, GMB offers the following findings and recommendations for design and construction:

1. Construct a new building to house the water treatment systems, electrical room and chemical storage/feed rooms near the site of the existing wellhouse for the Manchester Farms wells.
2. Install a PFAS removal system based on the GAC water treatment skid designed for treatment with two vessels in series, with a manually-alternated lead/lag arrangement.
3. Install a Fe/Mn removal system based on a three-vessel skid with manually-alternated lead/lag/standby arrangement.
4. Extend existing electrical service and supply.
5. Install new SCADA alarms.
6. Install a sanitary drain to discharge backwash to the adjacent Manchester Farms Sewage Pumping Station.

The recommended alternative is estimated at a construction cost of approximately $5.43 million.

1.0 GENERAL

The purpose of this report is to identify and examine the options for installing a new water treatment system in the Town of Manchester, Maryland, capable of treating flow from five (5) wells. These wells are the Patricia Court Well, Manchester Farms Wells B and D, and Park Ridge Wells 13A and 13B. The wells are typically operated up to 12 hours per day. Manchester Farms Wells B and D are not operated simultaneously, and Park Ridge Wells 13A and 13B are not operated simultaneously.

This study will discuss design parameters, configurations, and establish cost estimates for each alternative listed above. The operational and maintenance costs and non-economic considerations will be further analyzed to determine the most cost-effective option.

2.0 EXISTING FACILITIES

2.1 Location Map

The Project Area is located in the north-eastern portion of Carroll County, Maryland to the west of Maryland Route 30 on the south side of the Town of Manchester. The Manchester Farms site is an existing Town property where the existing Manchester Farms wellhouse/water treatment building is currently located and accessible by an access road (Footbridge Drive). The Patricia Court wellhouse is located on an access road which branches off of Patricia Court. The Park Ridge wellhouse is located along Washington Way. A vicinity map is included as exhibit EX-1.

The Project Area is located within the limits of the Town of Manchester. The proposed location of the new water treatment plant is adjacent to the existing wellhouse and a sewage pumping station and wet well. A location map is included as exhibit EX-2.

2.2 Condition of Existing Facilities and Water Quality

The maximum flow rate from each well and the measured PFOS/PFOA concentration are listed in Table 2-1, below. The EPA's proposed Maximum Contaminant Limit (MCL) for PFOS and PFOA are each 4 parts per trillion (ppt). Water quality test results and a water quality summary table are included in Appendix A.

Testing of the well water during the course of this project indicated elevated Iron (Fe) and Manganese (Mn) levels in several of the wells which are proposed to receive treatment for PFAS under this project. To reduce competition within the PFAS treatment media, pretreatment for Fe/Mn removal is proposed for all options to prolong the PFAS treatment media life. Pretreatment is designed as one skid with three (3) vessels to treat wells with elevated Fe/Mn in a lead/lag/standby arrangement. Valved piping shall be arranged such that operators can manually select which vessel is designated as the "lead" vessel. When the media in the "lead" vessel has been exhausted, it will be replaced and the vessel will be designated as “standby”. The former “lag” vessel will be designated as the new “lead” vessel, and the former “standby” vessel will be designated as “lag”.

Table 2-1: Well Flows and Quality

<table>
<tr><th>Well</th><th>Flow Rate (gpm)</th><th>PFOS (ppt)</th><th>PFOA (ppt)</th><th>Fe (mg/L)</th><th>Mn (mg/L)</th></tr>
<tr><td>Patricia Court Well</td><td>20</td><td>6.04</td><td>8.45</td><td>2.1</td><td>0.25</td></tr>
<tr><td>Manchester Farms Well B</td><td>78</td><td rowspan="2">2.6</td><td rowspan="2">4.6</td><td><0.05</td><td>0.012</td></tr>
<tr><td>Manchester Farms Well D</td><td>6</td><td>0.43</td><td>0.016</td></tr>
<tr><td>Park Ridge Well 13A</td><td>38</td><td rowspan="2">9.5</td><td rowspan="2">11</td><td>0.71</td><td>0.066</td></tr>
<tr><td>Park Ridge Well 13B</td><td>31</td><td><0.05</td><td>0.0095</td></tr>
</table>

The existing Manchester Farms wellhouse/water treatment contains the existing discharge manifold and injection points for chemical dosing as well as the well pump controls and electrical cabinet. The existing wellhouse may continue to be used for ancillary equipment and controls, but is too small to house a PFAS treatment system. To accommodate an adequate treatment system, a new treatment building will be constructed.

2.3 ENVIRONMENTAL RESOURCES PRESENT

A desktop analysis of environmental resources present in the subject area has been performed as a part of this report. A map showing the environmental resources present in and immediately around the proposed work is included as exhibit EX-3.

The proposed raw water supply main alignment is adjacent to the stream and forested buffer. The alignment is also in close proximity to a palustrine wetland, and approximately 300 feet away from a Group 1 Sensitive Species Area.

These environmentally sensitive areas will be delineated and taken into account during design. Construction of raw water supply mains through stream crossings shall be via directional drilling to reduce impacts to environmental resources where practical.

3.0 ALTERNATIVES

This report explores the application of two (2) different media types as treatment options to serve the Town of Manchester and provide a safe water source. Proposals from two (2) vendors were considered for each media type. Each of the presented systems is reviewed as a single skid that is responsible for treating the maximum combined flow from Patricia Court, the larger of the Park Ridge wells, and the larger of the Manchester Farms wells. The treatment skid is comprised of two (2) treatment vessels in a lead/lag arrangement. The lead/lag designation may be alternated by operators by operating a series of manual valves. In total, four (4) alternatives for PFAS treatment are analyzed in this report. Each treatment system presented addresses the public health concerns regarding PFAS removal.

Common improvements include replacement of the existing well pumps, construction of new raw water supply mains connected to the new water treatment plant, and construction of an Fe/Mn treatment system. The drain system and waste flows for each alternative shall be connected via a sanitary sewer connection that flows by gravity to the Manchester Farms Sewage Pump Station (SPS) on the same parcel which pumps to the collection system for the Manchester WWTP.

Please refer to Appendix B to see a building layout for each of the following alternatives. The product details for each of the below alternatives and for the Fe/Mn treatment system, a common improvement, is available in Appendix C.

3.1 AdEdge Granular Activated Carbon Treatment System

The first system reviewed is a granular activated carbon system, comprised of two vessels in a lead/lag arrangement. This system comprises one (1) skid containing two (2) 84-inch diameter vessels containing 185 cubic feet of granular activated carbon media per vessel as proposed by AdEdge. The skid is outfitted with a valve rack so that the lead/lag designation may be reversed via the operation of manual valves. Each vessel provides ten (10) minutes of empty bed contact time (EBCT). The proposed location to install the treatment system, adjacent to the existing wellhouse, will require construction of a new 38-feet by 34-feet treatment building and the installation of new piping to connect the well supply to the treatment system and the treatment system to the distribution. Approximately 42,000 gallons of backwash, supplied at a rate of 350 gpm, are required for the initial rinse and commissioning of the treatment system. Additional rinsing may be required to meet pH and arsenic requirements for drinking water.

3.2 Newterra Granular Activated Carbon Treatment System

This granular activated carbon system is comprised of two vessels in a lead/lag arrangement. This system comprises one (1) skid containing two (2) 72-inch diameter vessels containing 5,500 pounds of granular activated carbon media per vessel as proposed by Newterra. The skid is outfitted with a valve rack so that the lead/lag designation may be reversed via the operation of manual valves. Each vessel provides ten (10) minutes of empty bed contact time (EBCT). The proposed location to install the treatment system, adjacent to the existing wellhouse, will require construction of a new 38-feet by 34-feet treatment building and the installation of new piping to connect the well supply to the treatment system and the treatment system to the distribution. 11,000 gallons of backwash per vessel, to be provided at a rate of 250 gpm, are required in order to rinse and commission the GAC system. Additional rinsing may be required to meet pH and arsenic requirements for drinking water. 4,100 gallons of backwash are needed periodically for maintenance.

3.3 AdEdge Ion Exchange Treatment System

This ion exchange system is comprised of two vessels in a lead/lag arrangement. This system comprises one (1) skid containing two (2) 60-inch diameter vessels containing 60 cubic feet of ion exchange media per vessel as proposed by AdEdge. The skid is outfitted with a valve rack so that the lead/lag designation may be reversed via the operation of manual valves. Each vessel provides three (3) minutes of empty bed contact time (EBCT). The proposed location to install the treatment system, adjacent to the existing wellhouse, will require construction of a new 38-feet by 34-feet treatment building and the installation of new piping to connect the well supply to the treatment system and the treatment system to the distribution. Approximately 18,000 gallons of backwash, at a rate of 137 gpm, are required for the initial rinse and commissioning of the ion exchange system.

3.4 Newterra Ion Exchange Treatment System

This ion exchange system is comprised of two vessels in a lead/lag arrangement. This system comprises one (1) skid containing two (2) 66-inch diameter vessels containing 60 cubic feet of ion exchange media per vessel as proposed by Newterra. The skid is outfitted with a valve rack so that the lead/lag designation may be reversed via the operation of manual valves. Each vessel provides three (3) minutes of empty bed contact time (EBCT). The proposed location to install the treatment system, adjacent to the existing wellhouse, will require construction of a new 38-feet by 34-feet treatment building and the installation of new piping to connect the well supply to the treatment system and the treatment system to the distribution. 4,600 gallons of backwash, at a rate of 95 gpm, are needed in order to rinse each vessel and commission the ion exchange system.

4.0 DESIGN CONSIDERATIONS

4.1 COMMON IMPROVEMENTS

All alternatives considered shall include replacement of well pumps, construction of new supply mains to the new water treatment plant, a Fe/Mn treatment system, and new chemical feed systems.

Well pumps shall be adequately sized to preserve the existing well flow rate and required pressure in the water distribution system while accommodating the change in headloss as a result of the new supply main alignment and the new treatment equipment. The preliminary alignment of the new supply mains is shown in exhibit EX-3.

The Fe/Mn treatment system shall be a single skid with three (3) 30-inch diameter, 60-inch tall vessels capable of treating 137 gallons per minute (gpm), the maximum flow rate received by the new WTP. The three wells with Fe/Mn concentrations exceeding the Secondary Maximum Contaminant Level (SMCL) are Patricia Ct, Park Ridge Well A, and Manchester Farms Well D. Actuated valves will allow operators to direct the supply main from Park Ridge to the Fe/Mn treatment system prior to PFAS treatment when Park Ridge Well A is running, and will direct the supply main from Park Ridge directly to the PFAS treatment system when Park Ridge Well B is running. These two pumps shall be locked so that they may not both run simultaneously.

The new chemical feed systems shall supply soda ash, sulfur dioxide, and sodium hypochlorite to the well water during treatment. These chemicals will chlorinate raw water prior to Fe/Mn treatment, dechlorinate the water prior to PFAS treatment, adjust pH after PFAS treatment, and provide a chlorine residual prior to distribution. Pumps shall be adequately sized for peak flows from the wells, with adequate turndown to properly dose chemicals when smaller well pumps are running. Thirty (30) days of chemical storage shall be provided at the new WTP.

4.2 Media Replacement

Backwashing at commissioning and as needed for maintenance shall be accomplished through the use of drinking water. Drinking water shall be sourced from the discharge side of the new treatment equipment and shall be fitted with a Reduced Pressure Zone (RPZ) backflow preventer to prevent raw or partially treated water from entering the drinking water distribution system.

Vessels shall operate in a lead/lag arrangement until it is determined that the treatment capacity of the media in the lead vessel has been spent. At that time, the media in the lead vessel shall be replaced, and the spent media shall be disposed. The lead/lag designation shall be reversed via operation of the manual valves associated with the treatment skid. The preliminary estimate of media life and the replacement cost is summarized in the table below. This information is included in the Operating Costs for each alternative that are used in the Present Worth Analysis.

Table 4-1: Media Replacement Requirements of Water Treatment Alternatives

Alternative	Est. Media Replacement Cost (per vessel)	Media Replacement Frequency (days)
AdEdge GAC	$52,000	645
Newterra GAC	$67,000	680
AdEdge IX	$48,000	1,247
Newterra IX	$90,000	835

4.3 Pilot Testing

In order to evaluate the media life for the alternatives considered, pilot testing is required by MDE to demonstration treatment capacity with the selected media. A Rapid Small-Scale Column Test (RSSCT) shall be conducted for various treatment medias during the initial steps of the design phase. The results of this test shall be used to determine which type(s) of media provide cost-effective treatment of PFAS.

4.4 Environmental Impacts/Permitting

The location of the project should have minimal effects to the surrounding environmental resources. Supply mains which must cross the stream shall be constructed with directional drilling where practical to limit the environmental impacts.

The environmental impacts will be minimal and similar for all alternatives and not a factor in this evaluation. However, site design and stormwater management will require the design to include forest delineation, and wetlands delineation for the project site permitting and anticipated disturbances.

4.5 Additional Water Quality Treatment Requirements

While the exact requirements of future drinking water regulations would be difficult to estimate, as would the space required by future treatment technologies, the building layout should consider additional space to provide supplemental treatment or means to readily expand. In this instance, the building layout is provided to allow for future expansion and for the utilization of existing open space for use in future RSSCTs that may be used to evaluate the cost-effectiveness of a variety of media types immediately prior to the replacement of the treatment media in one vessel.

4.6 Electrical Design

The existing Manchester Farms wellhouse shall be used to house electrical equipment, including transformers and electrical panels. Electrical service may be extended via underground ductbank from the existing wellhouse to the new treatment building. treatment building shall include a dedicated electrical room that will hold all required electrical equipment, including transformers and electrical panels.

By constructing the electrical panels in a separate building, they will be isolated and properly separated in a controlled environment to improve operation and longevity of the electronic equipment. The separate electrical room will create space in the treatment room for operations or addition of future treatment processes, if needed.

Each skid proposed would require a 20 Amp service for operation. The existing generator which provides backup power to the Manchester Farms wellhouse shall continue to be used for the new treatment facility. A new backup generator shall be provided at the Patricia Farms wellhouse as a means of emergency/disaster resilience.

The new building would be provided with space heating via thermostat controlled electric unit heaters and forced air ventilation with thermostatically controlled centrifugal wall fans. Linear LED fixtures will be provided for interior lighting along with LED emergency lighting battery units. Exterior wall mounted LED fixtures with integral photo control will be provided at building entrance doors for security.

4.7 Raw Water Supply Mains

New raw water supply mains for Park Ridge and Patricia Court wells shall be constructed to facilitate centralized treatment at the Manchester Farms property. Pipelines shall be constructed in Town-owned properties, with the exception of an approximately 250-foot long segment along the Park Ridge supply main which will require a utility easement. Supply mains shall be constructed outside of environmentally sensitive areas to the extent practicable as shown in Exhibit EX-3.

4.8 Life Cycle Cost (Present Worth)

A Present Worth analysis takes into account the sum of all capital costs and O&M costs over 20 years minus the present worth of the total salvage cost for each item in 20 years.

Therefore, the total present worth equals a cost, if invested now at a given rate, that would provide exactly the funds required to make future payments.

The analysis provides an accurate comparison of future capital and O&M and is based on a 20-year real interest rate of 2%. Below is a table providing a summary of the capital cost, operation and maintenance cost, and the present worth for each alternative. Detailed estimates are provided in Appendix D.

Table 4-2: Estimated Life Cycle Costs of Water Treatment Alternatives

Alternative	Est. Capital Cost	Est. Annual O&M Costs	Est. Total Present Worth Costs
AdEdge GAC	$5,386,000	$208,210	$8,791,000
Newterra GAC	$5,477,000	$205,610	$8,840,000
Average GAC	**$5,431,500**	**$206,910**	**$8,815,500**
AdEdge IX	$5,398,000	$182,730	$8,386,000
Newterra IX	$5,387,000	$199,250	$8,646,000
Average IX	**$5,392,500**	**$190,990**	**$8,516,000**

4.9 NON-ECONOMIC CONSIDERATIONS

Two additional benefits of the GAC Treatment System are its operational flexibility and its ability to facilitate future expansion. The media in the vessels may be substituted with IX media in response to a change in well water characteristics or to increase the treatment capacity. Because the IX media requires only three (3) minutes of empty bed contact time (EBCT) whereas GAC media requires ten (10) minutes EBCT, GAC can be replaced with IX media within the existing vessel, but IX media cannot be replaced with GAC without the construction of additional vessels and modifications to the piping. As additional sampling results are gathered on the PFAS levels in the existing wells and as regulations change over time, the ability to substitute media within the existing vessel(s) may provide a critical ability to quickly respond to a future change in conditions or drinking water requirements.

5.0 CONCLUSIONS AND RECOMMENDATIONS

GMB recommends construction of a new treatment building with a GAC Treatment System for PFAS removal. This option provides greater flexibility for future treatment at 1% more capital cost and 8% greater annual O&M cost than the most cost-effective option. This facility has an estimated construction cost of approximately $5.43 million.

The recommended project includes:

- Rapid Small-Scale Column Testing to demonstrate treatment media for selection,
- Construction of a new treatment building, including extension of the existing electrical service, dedicated chemical storage and feed rooms, connection to the existing SCADA system, potable water service connection, and connection to the sanitary sewer system,
- Installation of an Fe/Mn pretreatment system for the combined flow from all wells with elevated Fe/Mn,
- Installation of an GAC water treatment system for the combined flow from all wells, and
- Construction of new raw water supply mains to the new water treatment plant and replacement of well pumps.

Permitting requirements for the design and construction are expected to require an MDE Construction Permit, County Building Permit, and Site Development. Stormwater Management and Erosion & Sediment control may also be required unless an exception can be obtained by maintaining the extent of disturbance below 5,000 square feet.