ENVIRONMENTAL PARTNERS
— An Apex Company —

MEMORANDUM

Date: August 18, 2022

To Mr. Maurice Goulet – Director, Town of Medfield Department of Public Works

From Eric Kelley, PE – Principal, Environmental Partners

CC Nicholas Milano, Assistant Town Administrator, Town of Medfield
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Medfield Board of Water and Sewage Commissioners
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Subject Wells 1, 2 & 6 PFAS Feasibility Study and Conceptual Design Memorandum

BACKGROUND AND PURPOSE

In October 2020, the Massachusetts Department of Environmental Protection (MassDEP) finalized revisions to the drinking water regulations (310 CMR 22), which now include a maximum contaminant level (MCL) for Per- and Polyfluoroalkyl Substances (PFAS). According to 310 CMR 22.07G, a water supplier will be in violation of the MCL if the quarterly average concentration of PFAS6, defined as the sum of six specific PFAS compounds, exceeds 20 parts per trillion (ppt) at the entry point to the distribution system. After observing PFAS levels in the water supply wells, the Town of Medfield (the Town) requested that Environmental Partners Group, LLC (EP) conduct a feasibility study to evaluate implementation of additional water treatment technologies to mitigate PFAS at three of the Town's public water supply wells (Wells 1, 2, & 6).

Since the Town decided to pursue the feasibility study, the regulatory environment concerning PFAS has continued to evolve. In June 2022, the United States Environmental Protection Agency (USEPA) published interim health advisories (IHAs) for two PFAS compounds, Perfluorooctanoic acid (PFOA) and Perfluoroctane sulfonate (PFOS). The IHAs for PFOA and PFOS are not enforceable standards, but they do provide insight into the USEPA's on-going rule-making process for drafting MCLs for PFOA and PFOS. The IHAs issued by USEPA are 0.004 ppt and 0.02 ppt for PFOA and PFOS, respectively. The IHAs are at levels that are significantly below current laboratory analytical method reporting limits (approximately 2 ppt) and are established based on potential adverse health effects over a lifetime of exposure. The USEPA anticipates publication of draft PFOA and PFOS MCLs in late 2022 and final issuance in 2023. The future MCLs will have to take into account feasibility of measuring the compounds, feasibility of treatment using available technology, and a cost-benefit analysis. The IHAs are considered to be advisory and USEPA is encouraging public water suppliers to take actions to reduce PFAS exposure.

In accordance with the current Massachusetts PFAS regulations, MassDEP is scheduled to reevaluate the Massachusetts PFAS6 MCL in 2023. Currently MassDEP does not anticipate the issuance of the IHAs will impact their PFAS regulations prior to this scheduled reevaluation next year. However, Massachusetts will ultimately need to adopt PFAS regulations which are as least as strict as USEPA's final regulations for PFOA and PFOS. While the PFAS6 concentrations at Wells 1 and 2 have remained under the Massachusetts MCL, the individual concentrations of PFOA and PFOS have both averaged slightly above 6 ppt since screening began in January 2021. This presents a future challenge in regards to MCL compliance as the USEPA has tentatively indicated that individual MCLs for PFOA and PFOS are likely to be established at levels below 6 ppt.

This memorandum presents the findings from the feasibility study and EP's conceptual design for PFAS treatment systems.

WATER SYSTEM SUMMARY

The Town supplies their community public water system using three wellfields comprised of six individual gravel-packed wells. Five of the wells (Wells 1, 2, 3, 4, & 6) are production wells, while the remaining well (Well 5) was drilled as an exploratory well and remains undeveloped. The supply system previously included the State Hospital Wellfield, an inactive tubular wellfield that formerly served the Medfield State Hospital. In 2021, the Town began construction of a water treatment facility to mitigate elevated iron and manganese levels at Wells 3 and 4. As a part of this treatment facility project, Well 3 will be abandoned, and a new well has been drilled adjacent to it (Well 3A).

At this time, the Town does not maintain any interconnection agreements with neighboring communities for emergency water supply.

EXISTING CONDITIONS

Wells 1, 2, and 6 are tributary to the Charles River Watershed. Wells 1 and 2 are both located within the Town's Wellfield A; Well 6 is located within Wellfield C. A locus map showing the well sites within the Town is provided in Figure 1. Existing conditions at the Wells 1 and 2, and Well 6 sites are presented in Figures 2 and 3, respectively. Figures showing the limits of Town-owned land and resource areas at each site are provided in Attachment 2. Fact sheets summarizing the existing conditions and design constraints at each site are provided in Attachment 3.

Wells 1 and 2

Wells 1 and 2 are gravel-packed wells, located along Main Street on a Town-owned parcel adjacent to the border between Medfield and Millis. The wells are housed in separate buildings, situated approximately 500 feet apart. Raw water is pumped from Well 1 through an 8-inch main to the Well 2 site, where it combines with raw water from Well 2. The blended water travels to an aeration tower, located behind Well Station 2, to strip volatile organic compounds (VOCs). Water from the aeration tower effluent collects in a below-grade clearwell.

Table 1 provides information on the existing well pumps.

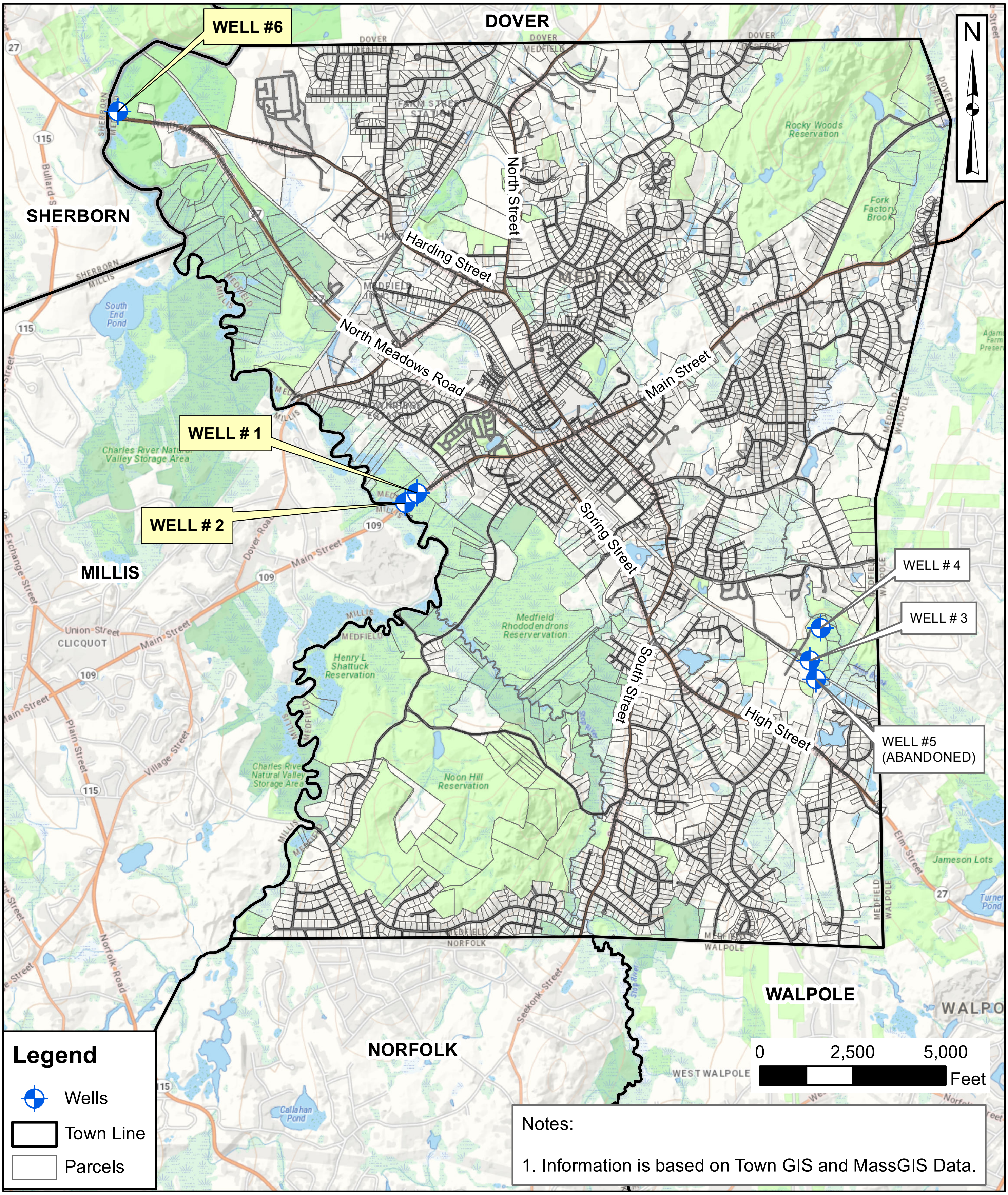
Table 1 – Wells 1 and 2 Well Pump Parameters

Parameter	Value	
	Well 1	Well 2
Pump Type	Vertical Turbine	Submersible
No. of Pumps	1	1
No. of Stages	7	2
Flow Capacity (gpm) (3)	300	600
Head (feet)	321	116 (1)
Motor Size (HP)	40	25 (2)
Drive	Variable	Variable

(1) Reported head is from the Well 2 Operation & Maintenance (O&M) manual. The 2019 pump test measured a head of 342' at 600 gpm.

(2) Reported horsepower is from Well 2 O&M manual. The 2016 Water Master Plan reported a motor rating of 75 HP.

(3) Average pumping flow rates for Wells 1 and 2 well pumps are 200 gpm and 500 gpm, respectively.



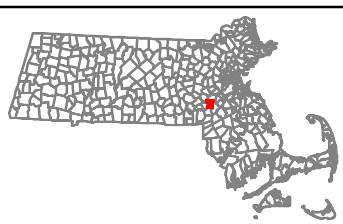


Figure 1: Town of Medfield Locus Map
Wells 1,2, & 6 PFAS Conceptual Design
Medfield, Massachusetts
August 2022

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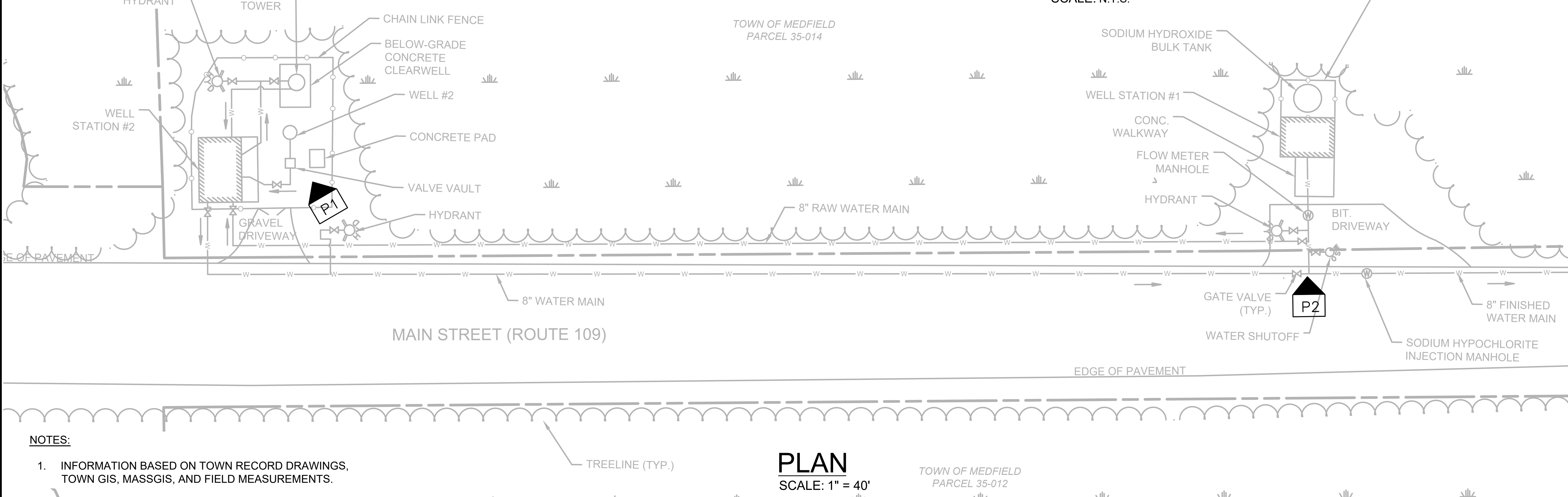
PICTURE 1 (P1): WELL STATION #2 & AERATION TOWER

SCALE: N.T.S.

PICTURE 2 (P2): WELL STATION #1

SCALE: N.T.S.



PLAN

SCALE: 1" = 40'

NOTES:

1. INFORMATION BASED ON TOWN RECORD DRAWINGS, TOWN GIS, MASSGIS, AND FIELD MEASUREMENTS.

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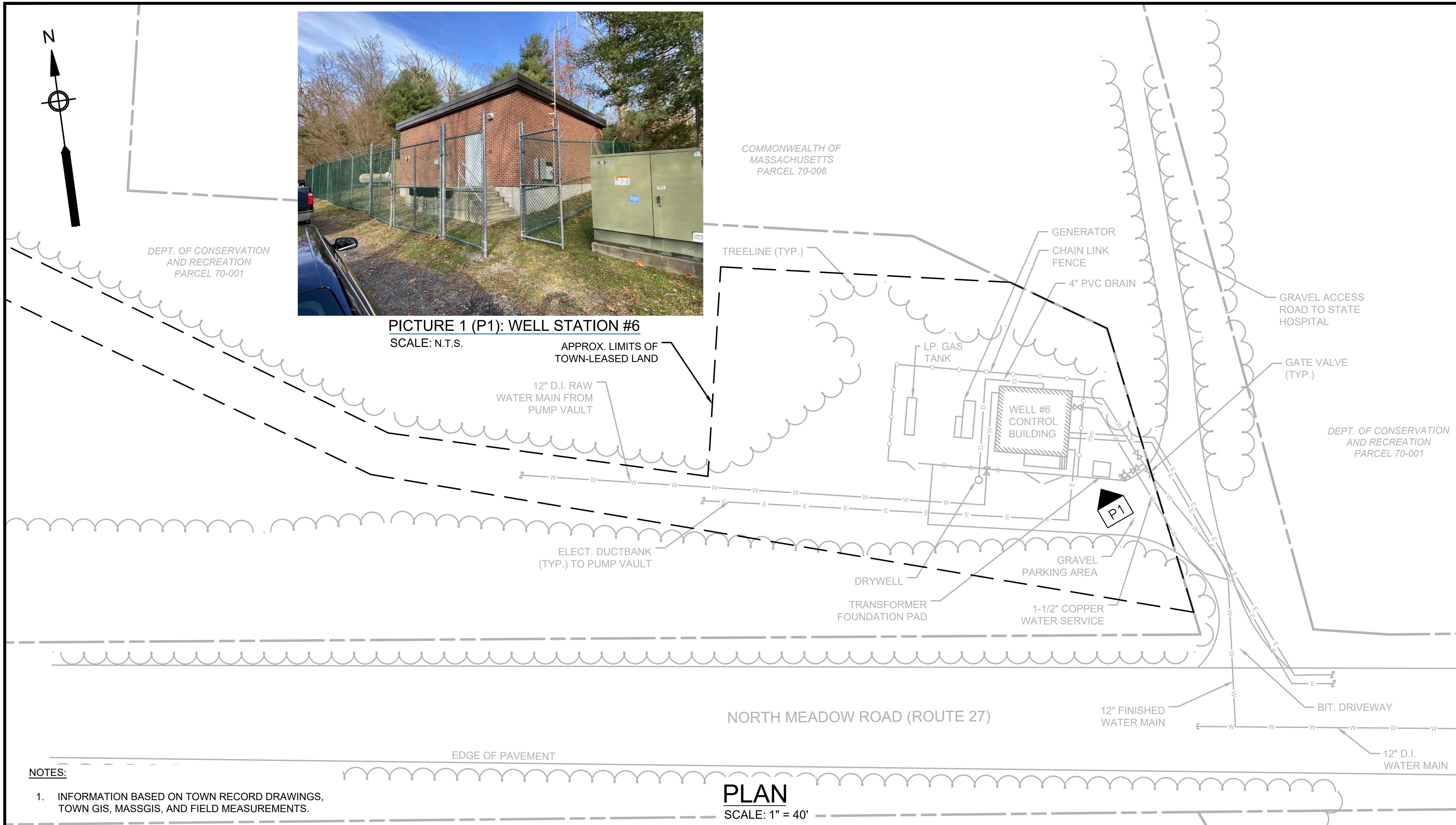
TOWN OF MEDFIELD 1651

AUGUST 2022	PFAS CONCEPTUAL DESIGN TOWN OF MEDFIELD, MASSACHUSETTS	
134-2102	FIGURE 2: WELLS 1 AND 2 EXISTING SITE PLAN AND YARD PIPING	

PICTURE 1 (P1): WELL STATION #6

SCALE: N.T.S.



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PLAN

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AUGUST 2022

134-2102

PFAS CONCEPTUAL DESIGN
TOWN OF MEDFIELD, MASSACHUSETTS

FIGURE 3: WELL 6 EXISTING SITE PLAN AND YARD PIPING

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The contents of the clearwell are pumped via two high flow pumps and one duty pump located beneath Well Station 2. The duty pump and one high flow pump operate in tandem, with the second high flow pump serving as redundancy. The pumps convey the aerated water through an 8-inch water main on Main Street back to Well 1 for chemical addition before entering the distribution system. For the purposes of this memorandum, these pumps are referred to as 'finished water pumps', despite being located upstream of the chemical addition point.

Table 2 provides information on the existing finished water pumps.

Table 2 – Well 1 and 2 Finished Water Pump Parameters

Parameter	Value	
	High Flow Pump	Low Flow Pump
Pump Type	Dry Pit Centrifugal	Dry Pit Centrifugal
No. of Pumps	2	1
Flow Capacity – each (gpm)	600	300
Head (feet)	289	255
Motor Size (HP)	60	30
Drive	Variable	Variable

The Well 1 site is equipped with a sodium hypochlorite feed system for disinfection and a sodium hydroxide feed system to provide corrosion control and pH adjustment. However, because sufficient pH control is achieved by the aeration tower, the sodium hydroxide system is not currently used. Chemical is injected at the chemical injection manhole located in front of Well Station 1 on Main Street. A sample tap is located in the Well Station 1 building for collecting finished water samples.

The average daily pumping volumes for Wells 1 and 2 in the 2021 calendar year were 91,500 gallons and 344,000 gallons, respectively. The maximum daily pumping volumes for Wells 1 and 2 in the 2021 calendar year were 170,000 gallons and 675,000 gallons, respectively. Based on information presented in the 2016 Water Master Plan, Well 1 and Well 2 have a DEP-approved safe yield of 230,000 gallons per day (gpd) and 610,000 gpd, respectively.

Each well station receives 480 volt, 3-phase, 100-amp power via an underground electrical duct bank. Neither site contains an on-site permanent stand-by generator; however, Well Station 2 has a portable generator connection that would operative via a manual transfer switch. The well pumps at each station are driven via wall mounted variable frequency drives (VFDs) located inside the well stations for start, stop and speed control. The Well Station 1 electrical system, with exception of the VFD, is past its useful life and in need of replacement. The Well Station 2 electrical system and the VFDs (Well 2 and Finished Water) are approaching the end of their useful life and should be considered for replacement. Refer to the attached Electrical Assessment Report in Attachment 4 for additional information on this facility's electrical infrastructure.

Well 6

Well 6 is a gravel-packed well located along North Meadow Road adjacent to the Medfield-Sherborn border. Well 6 is housed in a remote well building approximately 1,000 feet northwest of the Well 6 Control Building. Raw water is pumped from Well 6 to the control building, where sodium hypochlorite and sodium hydroxide are injected before it enters the distribution system. The Well 6 site is within the state-owned Charles River Reservation, and the Town maintains a leased easement from the Massachusetts Department of Natural Resources that encompasses the control building, well building, and portion of the Zone I area within the Town of Medfield.

In May 2022, the well pump failed and the station went offline for approximately 6-weeks before a new pump was installed. At the time of the new pump installation, the well was cleaned and redeveloped. Table 3 provides information on the new well pump and motor installed in June 2022.

Table 3 – Well 6 Raw Water Well Pump Parameters

Parameter	Value
Pump Type	Submersible
No. of Pumps	1
No. of Stages	7
Flow Capacity (gpm)	1,100
Head (feet)	406
Motor Size (HP)	150
Drive	Variable

Note: Average pumping flow rate for Well 6 well pump is 900 gpm.

The average and maximum daily pumping volumes for Well 6 in the 2021 calendar year were 580,000 gallons and 1,090,000 gallons, respectively. Based on information presented in the 2016 Water Master Plan, Well 6 has a DEP-approved safe yield of 1,580,000 gpd.

Well Station 6 receives 277/480 volt, 3-phase, 400-amp power via an underground electrical duct bank. The station receives stand-by power via a 180 KW propane generator that operates via an automatic transfer switch located inside the well station. The well pump at Well 6 is driven via a wall mounted VFD located inside the well station for start, stop and speed control. The existing electrical system is in good condition and does not require immediate replacement due to its condition. Refer to the attached Electrical Assessment Report in Attachment 4 for additional information on the well station's electrical infrastructure.

WATER QUALITY

Based on review of available drinking water quality data from the Massachusetts Energy and Environmental Affairs Data Portal, finished water quality data from Wells 1, 2, and 6 are generally typical of water systems tributary to the Charles River Watershed.

Table 4 provides a summary of the available water quality data.

Table 4 – Summary of Average Finished Water Quality Data 2019-2021

Sample Date	Constituent Levels (mg/L)	
	Wells 1 and 2	Well 6
Calcium	63.00	88.50
Chloride	37.95	30.10
Iron	0.08	0.13
Magnesium	10.70	5.23
Manganese	ND	0.10
Sulfate	24.60	17.90
Total Alkalinity as $CaCO_3$	63.00	88.50
Total Hardness as $CaCO_3$	141.50	101.05
Turbidity	0.35	0.35

Note: ND = Non-detect

Additionally, EP identified elevated levels of the following compounds at each well site:

- Well 1 and 2 : VOCs, Iron, and PFAS.
- Well 6: Iron, manganese, and PFAS present, but low risk of exceeding the current PFAS6 MCL.

The Town successfully treats VOCs at Wells 1 and 2 using the aeration tower at the Well 2 site. However, the Town's PFAS detections are relatively recent and are described in greater detail herein. The presence of slightly elevated iron and manganese in Well 6 could impact hydraulic performance of PFAS treatment systems and thereby require periodic backwashing to remove iron and manganese particulate from the top of PFAS media beds. Additional water quality monitoring is recommended as part of further design efforts to evaluate the potential for interference with PFAS treatment.

Per- and Poly-Fluoroalkyl Alkyl Substances

In October 2020, MassDEP published a PFAS public drinking water standard MCL of 20 ppt for the sum of the following six PFAS chemicals (known as PFAS6):

- Perfluorooctanoic acid (PFOA)
- Perfluoroctane sulfonate (PFOS)
- Perfluorononanoic acid (PFNA)
- Perfluorohexane sulfonic acid (PFHxS)
- Perfluoroheptanoic acid (PFHpA)
- Perfluorodecanoic acid (PFDA)

It is important to note that the Environmental Protection Agency (EPA) published updated health advisories (HAs) for four PFAS chemicals, interim HAs for PFOA and PFOS and final HAs for GenX and PFBS in June 2022. The final HAs for GenX and PFBS are not of significant concern as their standards (10 ppt and 2,000 ppt, respectively) are significantly higher than levels generally observed in public drinking water in Massachusetts. Medfield's PFAS screening has not observed GenX at concentrations above the laboratory reporting limit (approximately 2 ppt) and PFBS levels were observed at approximately 2 ppt since screening began in January 2021. As discussed previously the USEPA is expected to issue draft MCLs for PFOA and PFOS in late 2022 and final MCLs in 2023. It is possible that the MassDEP may revise the PFAS6 MCL or issue individual PFAS compound MCLs as a result of EPA's regulatory actions when they reconsider the PFAS6 MCL in 2023.

As part of the MassDEP's PFAS sampling grant, the Town completed an initial screening of their five active public water supply wells in January 2021 and a confirmatory round of sampling in March 2021. PFAS6 levels from the initial screening, collected at each well's point of entry into the distribution system, were all below the 20 ppt MassDEP MCL. At Wells 1, 2, and 3, results exceeded 10 ppt, and, in compliance with MassDEP requirements, the Town has continued with monthly PFAS water quality screenings of these three wells since April 2021. Levels at Wells 4 and 6 were both below 10 ppt, which requires sampling only once per quarter. PFAS levels in Well 3 have decreased below 10 ppt since the initial screening. PFAS levels in Wells 1 and 2 have remained consistently above 10 ppt but below the 20 ppt MassDEP MCL. PFAS levels in Wells 4 and 6 have remained below 10 ppt during monitoring completed to date. Table 5 provides historic PFAS sampling results for the Wells 1 and 2 and Well 6 sample points.

Table 5 – Historic PFAS6 Levels at Wells 1 and 2 and Well 6 Sample Points

Sample Date	PFAS6 Levels (ppt) [(1)]	
	Wells 1 and 2	Well 6
January 2021	18.0	4.3
February 2021	13.0	ND
March 2021	Not sampled	Not sampled
April 2021	16.4	ND
May 2021	N/A [(2)]	Not sampled
June 2021 - 6/9 sample	17.3	Not sampled
June 2021 - 6/23 sample	19.1	Not sampled
July 2021	19.0	7.3
August 2021	19.1	Not sampled
September 2021	18.0	Not sampled
October 2021	17.6	5.2
November 2021	19.6	Not sampled
December 2021	18.8	Not sampled
January 2022	16.4	4.3
February 2022	20.4	Not sampled
March 2022	20.4	Not sampled
April 2022	17.6	Not sampled
May 2022	18.6	Not sampled
June 2022	18.2	Not sampled
July 2022	16.2	Not sampled
Average	**18.1**	**4.8**

(1) ND = Non-detect.

(2) Re-sampled on 6/9 due to lab error.

Given these results, the Town procured EP to evaluate PFAS treatment options at Wells 1, 2 and 6 to mitigate elevated levels of PFAS6 and maintain compliance with the current MassDEP MCL. The three well stations are equipped with existing treatment systems, but these are not effective in removing PFAS; and well station upgrades and new equipment would be required to treat PFAS6.

The new Well 3A and 4 Water Treatment Plant (WTP) currently in construction includes provisions for the installation of a future PFAS treatment system should PFAS6 levels exceed the MassDEP MCL. Therefore, these wells were not included in the scope of this conceptual design. PFAS6 concentrations at Well 3 and Well 4 have generally been non-detect since screening began in January 2021. The applicability of PFAS treatment at the Wells 3 and 4 WTP will have to be reevaluated with changes in PFAS drinking water standards.

Based upon the PFAS results collected to date, Environmental Partners recommends the Town consider completing an environmental due diligence assessment of the Well 1 and Well 2 area to identify potential sources of PFAS impacting the Town's water supply wells.

INTERIM PFAS RESPONSE PLAN

Once construction of the Well 3 and 4 WTP is complete, which is expected by early 2023, the Town will be able to meet water system demands with Wells 1 & 2 or Well 6 offline. As temporary PFAS treatment equipment can ultimately be more expensive than permanent solutions and is in short supply after MassDEP released the revised MCL, EP does not recommend procuring an interim PFAS response system at Wells 1, 2, or 6. Given the current equipment lead times associated with interim PFAS treatment technologies, a temporary PFAS treatment system would not be commissioned until after the completion of Well 3 and 4 WTP and thus is not cost-effective. Therefore, if PFAS6 sampling at Wells 1, 2, or 6 exceeds the 20 ppt MCL, it is recommended that the Town first temporarily take the affected well out-of-service, continue using the other existing wells to meet the system demand, and proceed with implementing the permanent PFAS response plan outlined below.

PERMANENT PFAS SYSTEM CONCEPTUAL DESIGN

EP recommends the Town construct a permanent PFAS treatment system at one of the well sites that can be operated if PFAS6 levels exceed the MCL. The two treatment technologies evaluated as part of the conceptual design were Ion Exchange (IX) or Granular Activated Carbon (GAC). IX and GAC treatment technologies for PFAS removal generally consist of installation of steel pressure vessels in lead-lag configuration. These vessels are then filled with IX resin or GAC filter media.

TREATMENT TECHNOLOGIES

Both IX and GAC are well-proven technologies for PFAS removal and there are several specific GAC and IX products that are approved by MassDEP for PFAS treatment. Some general information about GAC and IX media are summarized in the bullets below.

- GAC Media:
    - Proven technology for adsorption of various compounds including PFAS.

  - Typically requires larger media volume (i.e. larger vessels) as compared to an equivalent IX system.
  - Typically shorter bed life as compared to IX media depending on PFAS contaminants of concern.
  - Design guidelines recommend the system provide for 10 minutes of empty bed contact time (EBCT).
  - PFAS removal efficiency may vary between long and short chain PFAS compounds.
  - Typically the unit cost for GAC media is less than IX media.
  - Potential for spent GAC media to be reactivated to reduce media replacement costs.
  - Media must be backwashed after installation to remove fines from transportation and installation.
  - Some GAC media may require pre-conditioning by running to waste or chemically treating with an acid wash to reduce elevated pH of treated water during start-up activities.
  - GAC media may require periodic maintenance backwashes after installation to remove accumulated particles that reduce hydraulic performance of the GAC system.
  - Management of spent backwash water is a consideration to evaluate during detailed design (i.e. internal recycling or sewer discharge).
- IX Media:
  - Proven technology for adsorption of various compounds including PFAS, but not as well established as compared to GAC.
  - Typically requires smaller media volume (i.e. smaller vessels) as compared to an equivalent GAC system.
  - Typically longer bed life as compared to GAC media depending on PFAS contaminants of concern.
  - Design guidelines recommend the system provide for three to five minutes of EBCT.
  - PFAS removal efficiency may vary between long and short chain PFAS compounds and research is on-going on engineering IX media for enhanced removal of specific PFAS compounds.
  - Typically the unit cost for IX media is more than GAC media.
  - Typically requires more pre-treatment requirements (iron/manganese removal, dechlorination) than GAC media systems.
  - Currently considered single-use media and media typically managed as hazardous material, which can significantly impact transportation and disposal costs.
  - Some IX must be conditioned after installation to address elevated chloride/sulfate concentrations, which may have an impact on a water systems corrosion control practices. Media manufactures can supply media that has been buffered to reduce the level of pre-conditioning required prior to operation of the system.
  - IX media may require periodic maintenance backwashes after installation to remove accumulated fines that reduce hydraulic performance of the system, but washwater may require pre-treatment (dechlorination). The maintenance wash requirements of specific IX media would need to be discussed with suppliers during detailed design.
  - Management of spent backwash water is a consideration to evaluate during detailed design (i.e. internal recycling or sewer discharge).

Based on preliminary correspondence with vendors (Suez, Calgon, and Evoqua), the necessary treatment equipment to implement either technology will have similar overall space requirements and capital costs, but carry substantially different operation/maintenance costs.

Table 6 provides a summary of the PFAS treatment technologies considered. This table compares IX and GAC treatment system options based on three feasible configurations. The design flow rate for the Well 2 raw water pump capacity is the design basis for the Raw Water Connection option, the combined flow rate for the finished water pumps at the Well 2 site is the design basis for the Aerated Water Connection option, and the design capacity of the Well 6 raw water pump is the design basis for the Well 6 treatment system. The Well 1 and 2 Raw Water Connection option offers the Town flexibility to treat raw water from Wells 1 and/or 2 and reduces the required treatment building footprint but will reduce the total combined flow when both wells are in service. All costs presented below in Table 6 are from March 2022.

Table 6 – Summary of PFAS Treatment Technologies

Parameter	Ion Exchange			Granular Activated Carbon		
	Wells 1 and 2		Well 6	Wells 1 and 2		Well 6
Water Connection	Raw	Aerated	Raw	Raw	Aerated	Raw
Design Flow (gpm)	600	900	1,100	600	900	1,100
Approx. Bed Life (1)	20 months	66 months	66 months	18 months	25 months	25 months
Approx. Capital Cost(2)	$ 480,000	$ 700,000	$ 700,000	$ 630,000	$ 710,000	$ 710,000
Approx. Rebed Cost	$ 190,000	$ 320,000	$ 320,000	$ 150,000	$ 180,000	$ 180,000
Approx. Media Disposal Cost (3)	$ 40,000	$ 80,000	$ 80,000	-	-	-
Estimated Media Replacements over 10 Years	6	2	2	7	5	5
Approx. 10-Year Cost(4)	$ 1.4 million	$ 0.8 million	$ 0.8 million	$ 1.1 million	$ 0.9 million	$ 0.9 million

(1) Approximate Bed Life is determined based on PFAS removal alone; other constituents in the water supply (VOCs, TOCs, metals, etc.) may result in reduced bed life or result in other problems and that require media exchange prior to PFAS breakthrough.
(2) Approximate capital cost includes the conservative material costs of the treatment vessels, media, and face piping as quoted by vendors.
(3) Media disposal costs are not included for GAC treatment systems because reactivation of spent carbon is included in the approximate rebed cost.
(4) Approximate 10-Year O&M Cost reflects media rebed and disposal costs based on estimated bed life and number of replacements in first 10 years. All costs in 2022 dollars with no inflation over 10 year period.

As presented in Table 6, capital and O&M costs for IX and GAC systems are comparable to each other based upon vendor estimated PFAS media lifespans. A treatability study could be performed to refine the media bed life estimates to further assess IX and GAC medias for suitability with a specific water source. For the purposes of this evaluation proposed GAC alternatives are described in greater detail in the following sections.

WELLS 1 AND 2 TREATMENT SYSTEM

The proposed PFAS treatment system for Wells 1 and 2 will include two vertical pressure filters containing GAC media in a lead-lag configuration. At this stage of design, EP evaluated PFAS treatment that would connect to either the raw or aerated water system with a total maximum capacity rating of 0.86 MGD (600 gpm) and 1.3 MGD (900 gpm), respectively. Due to the size of the pressure vessels and limited available space in existing well station buildings, the treatment system will be located within a permanent standalone structure. During the next phase of design, EP will subcontract with an Architect to complete a code review of the new treatment system structure.

Based on similar project experience and discussions with GAC filtration vendors, EP expects that the GAC filtration system will require intermittent maintenance washes (backwashes) to reduce head loss through the PFAS treatment system. Washwater for the backwash process would be supplied from the distribution system.

Backwash waste will be disposed of through the Town's existing wastewater system. The existing wastewater system terminates to the east of the well sites, at the intersection of Main Street and Bridge Street. To convey the backwash waste to the wastewater system, a new pump station will be required at the treatment system site. The pump station will consist of a below grade wet well with two submersible wastewater pumps. The pumps will be sized based on the maximum required backwash flowrate to minimize the wet well size. The pumps will discharge through a minimum 3-inch diameter PVC force main to the existing wastewater manhole at the intersection of Main Street and Bridge Street.

The residuals management approach would require further discussion with the Town's sewer division staff to determine if periodic discharges of spent backwash water would impact the collection system or wastewater treatment facility. The frequency of maintenance washes would be evaluated further during design, but existing systems have required periodic maintenance washes on a weekly to semi-annual basis depending on site specific water quality conditions. If PFAS-treated water is available for backwashing then the presence of elevated PFAS compounds in the residuals discharge are minimized. Currently in Massachusetts medium sized wastewater treatment facilities like the Town's do not have a PFAS limit in their discharge permit. As the PFAS regulatory environment evolves further this could become an issue for further discussion with sewer division staff and regulatory agencies.

Site and System Connection Considerations

The Well 1 and 2 sites are both surrounded by wetlands located on the northern, western, and eastern borders, with Main Street establishing the southern border, which strictly limits available space for the proposed PFAS treatment system. To determine the most cost-effective approach, multiple treatment system locations and orientations were evaluated at each site. The Well 1 site configuration requires connecting the proposed treatment system to the aerated water main to avoid installing a significant amount of new parallel water main between the two stations. However, the Well 2 site configuration provided the option of connection to either the raw water or aerated water main.

It should be noted that the existing pull-off area located along the Main Street westbound travel lane between the Well Station 1 and Bridge Street was evaluated for the new treatment system site. However, based on the Town's assessor database, this land is owned by the Army Corps of Engineers and would require authorization for the Town's use. For this reason, EP eliminated this site as a feasible location for the new treatment system. This site can be further evaluated at the request of the Town.

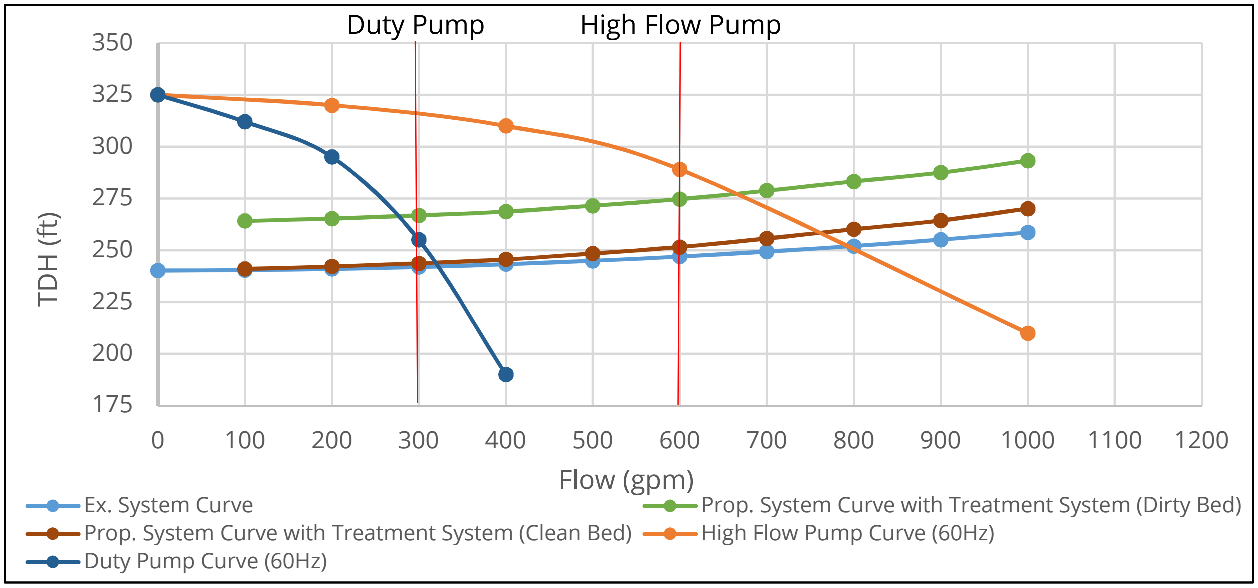
Well 1 Site - Aerated Water Connection

An area on the southeast corner of the Well 1 site was identified for the proposed treatment system, as presented in Figure 4. For this option, the proposed treatment system inlet and outlet piping is connected to the blended Well 1 and 2 aerated water main along Main Street, just upstream of the existing chemical injection manhole. The existing water main between the inlet and outlet connection points will be cut and capped to control the flow direction. Sodium hypochlorite addition will remain at the existing chemical injection manhole, downstream of the treatment system to ensure residual chlorine concentrations are not affected by the GAC.

Treatment System Constraints

The finished water pumps at the Well 2 site will be responsible for pumping water through the PFAS treatment system, which will introduce additional head loss. The system hydraulics were evaluated to assess whether the existing finished water pumps could accommodate the additional head loss at a flow rate of 900 gpm. Figure 5 presents the existing and proposed system curves compared to the current pump curves.

Figure 5 – Wells 1 & 2 Finished Water Pump and System Curve



Note: A 10 psi increase in head loss through the treatment system is used between the clean bed and dirty bed.

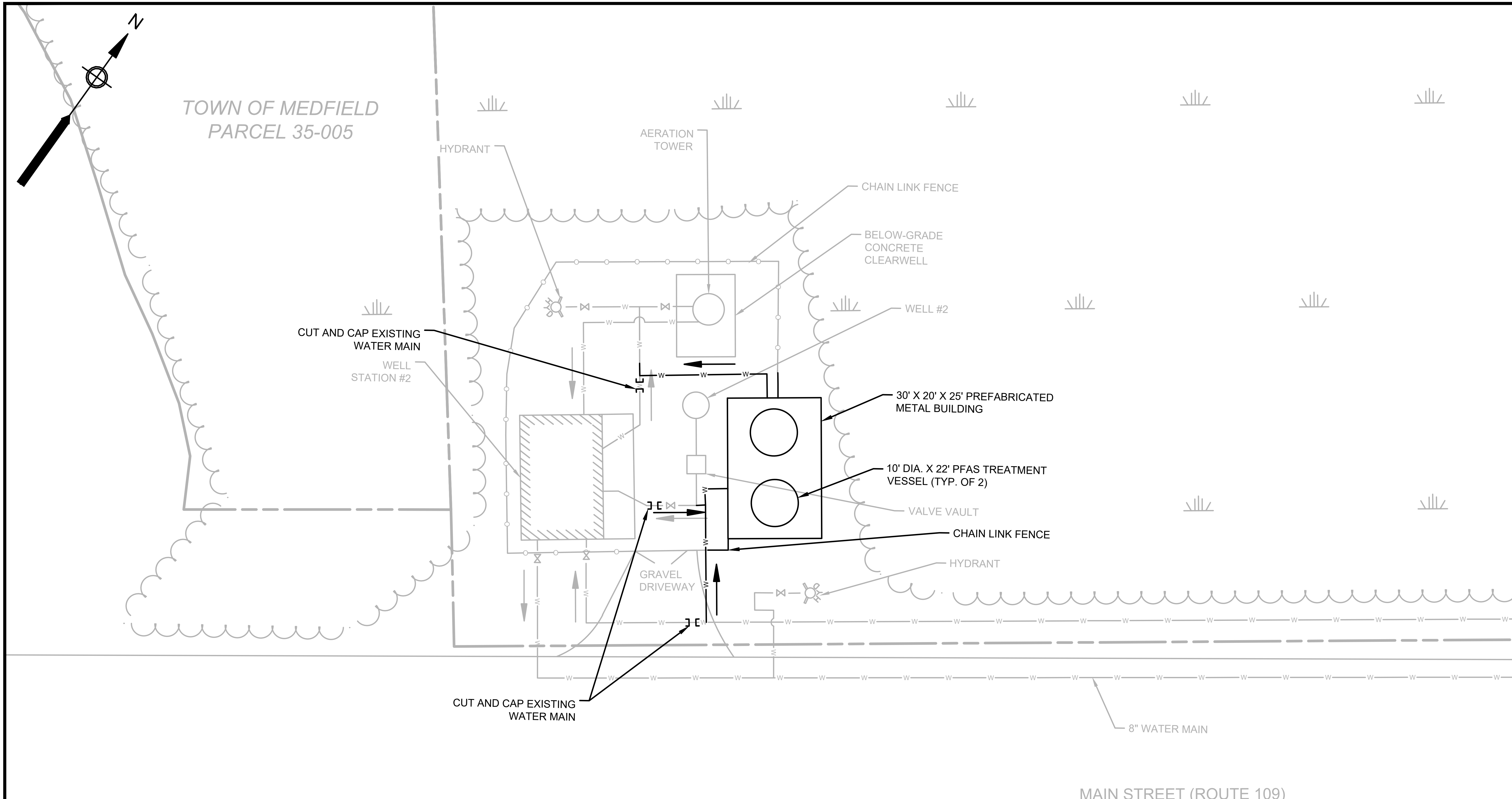
As shown in Figure 5, the existing high flow finished water pump can accommodate the additional head loss introduced by the treatment system. However, the duty pump will not be able to pump the required flow through the dirty filter bed. To ensure the finished water pumps can accommodate the added system pressure associated with the new treatment system and to simplify the finished water pump system operation, EP recommends demolishing the existing low flow finished water pump and replacing the existing high flow finished water pumps with two new centrifugal pumps, each capable of pumping the combined Well 1 and 2 flow of 900 gpm.

Table 7 provides the initial design parameters for the proposed new finished water pumps.

Table 7 – Proposed Finish Water Pump Design Parameters

Parameter	Value
Pump Type	Dry-Pit Centrifugal
No. of Pumps	2
Flow Capacity – each (gpm)	900
Head (feet)	290
Motor Size (HP)	100

Further evaluation of the existing pumps and additional headloss associated with the proposed PFAS treatment system is required during the Preliminary Design to verify if the existing pumps can be re-used. EP recommends performing a pump test to confirm the existing finished water pumping capacities and system pressures. The detailed hydraulic analysis will be based on the current pumping system operating range and proposed flow conditions to efficiently operate the treatment system.



NOTES:

1. INFORMATION BASED ON TOWN RECORD DRAWINGS, TOWN GIS, MASSGIS, AND FIELD MEASUREMENTS.

PLAN

SCALE: 1" = 20'

ENVIRONMENTAL PARTNERS — An Apex Company —	TOWN OF MEDFIELD 1651	AUGUST 2022 134-2102	PFAS CONCEPTUAL DESIGN TOWN OF MEDFIELD, MASSACHUSETTS FIGURE 6: WELL 2 SITE PLAN AND YARD PIPING RAW WATER GAC PFAS TREATMENT EQUIPMENT

I:\MEDFIELD.134\WATER SYSTEM\134-2102 - PFAS\03 CONCEPTUAL DESIGN\CAD\WELL SITE PLANS - 3.10.22.DWG

Required Modifications

Modifications to the existing pump systems and site to implement PFAS treatment at the Well 1 site include but are not limited to the following:

- Construct new PFAS treatment building to house the GAC filtration vessels.
- Install influent/effluent PFAS treatment piping to and from the aerated water main.
- Cut and cap portion of existing water main between treatment system connection points.
- Construct new pump station and force main for backwash waste disposal.
- Remove and replace the finished water pumps.
- Restore disturbed area around new treatment area.
- Replace well station electrical power system with new 480-volt main panel board and 15KVA transformer, including new conduit, wiring, and receptacles.
- Install new electrical feeder dedicated to the PFAS treatment area.
- Install power distribution equipment for all proposed equipment in the PFAS treatment area.
- Upgrade electrical feeder for new finished water pumps.
- Install normal and emergency lighting systems in the PFAS treatment area.
- Install heating and ventilation systems in the PFAS treatment area to maintain customary air temperature and quality.
- Install floor drains in the PFAS treatment area and route flow to the proposed wastewater pump station.
- Install standby generator for Well 1, Well 2, and appurtenances.
- Replace well station lighting system including emergency lighting battery unit.
- Complete any additional improvements, as directed by the Town.

Well 2 Site – Raw Water Connection

Space was identified on the southeast corner of the Well 2 site for the proposed treatment system with connections to the raw water main, as presented in Figure 6. For this option, the proposed treatment system inlet piping connects to the Well 1 raw water main along Main Street and the Well 2 discharge piping on the Well 2 site. Existing gate valves on the Well 1 raw water main and Well 2 discharge piping will control the flow direction. The treatment system outlet piping will continue to the aeration tower and clearwell. Once in the clearwell, the system will operate as it currently does, using the finished water pumps to convey the treated water to the Well 1 site for disinfection before entering the distribution system.

Treatment System Constraints

The Well 1 and 2 raw water well pumps will be responsible for pumping water through the PFAS treatment system, which will introduce additional head loss to the system. The raw water system hydraulics were evaluated to assess if the existing Well 1 and 2 pumps could accommodate the added head loss at their current design flow rate of 300 gpm and 600 gpm, respectively. Based on the existing Well 1 pump operating point, the pump appears to be sized for pumping directly to the distribution system rather than to the clearwell. Therefore, the existing Well 1 pump can accommodate the additional head loss through the proposed treatment system due to being oversized for the current pumping condition. Due to conflicting information between the 2019 pump test performed by Maher Services and the Well 2 pump Operation and Maintenance Manual, EP recommends performing a formal pump test to verify the existing pump operating range. For the purposes of this conceptual design, EP assumes the Well 2 pump will need to be upgraded to accommodate the additional treatment system head loss as a conservative approach.

Well 2 Site - Aerated Water Connection

Similar to the Raw Water Connection, space was identified on the southeast corner of the Well 2 site for the proposed treatment system with connections to the finished water main, as presented in Figure 7. For this option, the proposed treatment system inlet and outlet piping connects to the finished water main along Main Street, just downstream of the finished water pumps (upstream of the existing chemical injection manhole). The existing water main between the inlet and outlet connection points will be cut and capped to control the flow direction Sodium hypochlorite addition will remain at the existing chemical injection manhole, downstream of the treatment system to ensure residual chlorine concentrations are not affected by the GAC.

Treatment System Constraints

Similar to the Well 1 site Aerated Water Connection, the finished water pumps at the Well 2 site will be responsible for pumping water through the PFAS treatment system, which will introduce additional head loss to the system. As indicated in the Well 1 Site – Aerated Water Connection section above and as shown in Figure 5, the existing finished water pumps can accommodate the additional head loss introduced by the treatment system.

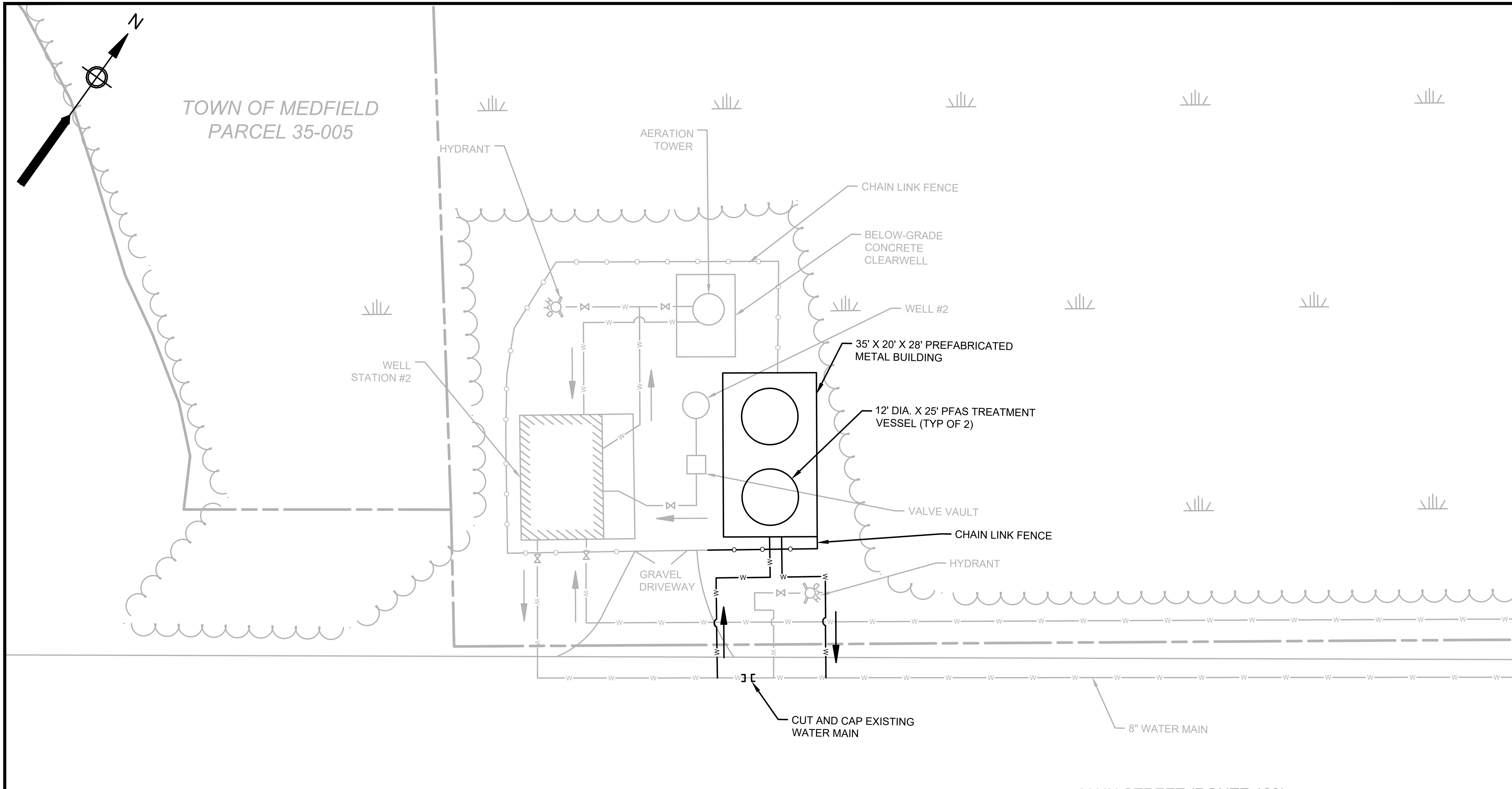
However, EP recommends demolishing the existing low flow finished water pump and replacing the existing high flow finished water pumps with new pumps each capable of pumping the combined Well 1 and 2 flow of 900 gpm to simplify and improve the finished water pump system operation.

Required Modifications

Under either the Well 2 site Raw Water or Aerated Water Connection, modifications to the existing pump systems and site to implement PFAS treatment at the Well 2 site include but are not limited to the following:

- Construct new PFAS treatment building to house the GAC filtration vessels.
- Install influent/effluent PFAS treatment piping to and from the raw or aerated water main.
- Remove and replace the existing finished water pumps.
- Remove and replace the existing Well 2 pump.
- Cut and cap portion of existing water main between treatment system connection points.
- Construct new pump station and force main for backwash waste disposal.
- Replacement of the finished water pumps (Raw Water and Aerated Water Connection)
- Restore disturbed area around new treatment area.
- Upgrade electrical service to a 277/480-volt, 600 amp, 3-phase, 4-wire service.
- Replace existing motor control cabinet and manual transfer switch (MTS) with a 600 amp circuit breaker and 600 amp MTS.
- Replace VFD and connect to new service.
- Install new feeder dedicated to the PFAS treatment area.
- Install power distribution equipment for all proposed equipment in the PFAS treatment area.
- Install normal and emergency lighting systems in the PFAS treatment area.
- Install heating and ventilation systems in the PFAS treatment area to maintain customary air temperature and quality.

- Install floor drains in the PFAS treatment area and route flow to the proposed wastewater pump station.
- Install standby generator for Well 1, Well 2 and appurtenances.
- Replace well station lighting system including emergency lighting battery unit.
- Complete any additional improvements, as directed by the Town.



NOTES:

1. INFORMATION BASED ON TOWN RECORD DRAWINGS, TOWN GIS, MASSGIS, AND FIELD MEASUREMENTS.

PLAN

SCALE: 1" = 20'

ENVIRONMENTAL PARTNERS
— An Apex Company —

AUGUST 2022

134-2102

PFAS CONCEPTUAL DESIGN
TOWN OF MEDFIELD, MASSACHUSETTS

FIGURE 7: WELL 2 SITE PLAN AND YARD PIPING
AERATED WATER GAC PFAS TREATMENT EQUIPMENT

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WELL 6 TREATMENT SYSTEM

As previously indicated, quarterly sampling dating back to January 2021 suggests that Well 6 is unlikely to exceed the current PFAS6 MCL, so it is not currently necessary to implement a PFAS treatment system at this site based on current Massachusetts PFAS6 standards. However, EP included Well 6 in this study as changes to regulatory requirements or the well's water quality may require future treatment.

The proposed PFAS treatment system for Well 6 includes two vertical pressure filters containing GAC media in a lead-lag configuration. The PFAS treatment system for raw water provides a total maximum capacity rating of 1.6 MGD (1,100 gpm). The treatment system will be located within a permanent standalone structure. If the Town elects to provide PFAS treatment at Well 6, EP will subcontract with an Architect to complete a code review of the new treatment system structure during the next phase of design.

Similar to the Well 1 and 2 treatment system, the Well 6 GAC filtration system will require intermittent backwashes to reduce head loss through the PFAS treatment system. Washwater for the backwash process would be supplied from the existing finished water main located at the Well 6 site via the raw water well pump. Construction of a backwash waste disposal system will be required. Options considered include construction of a pump station with a connection to the nearest wastewater system or construction of a residual basin at the Well 6 site.

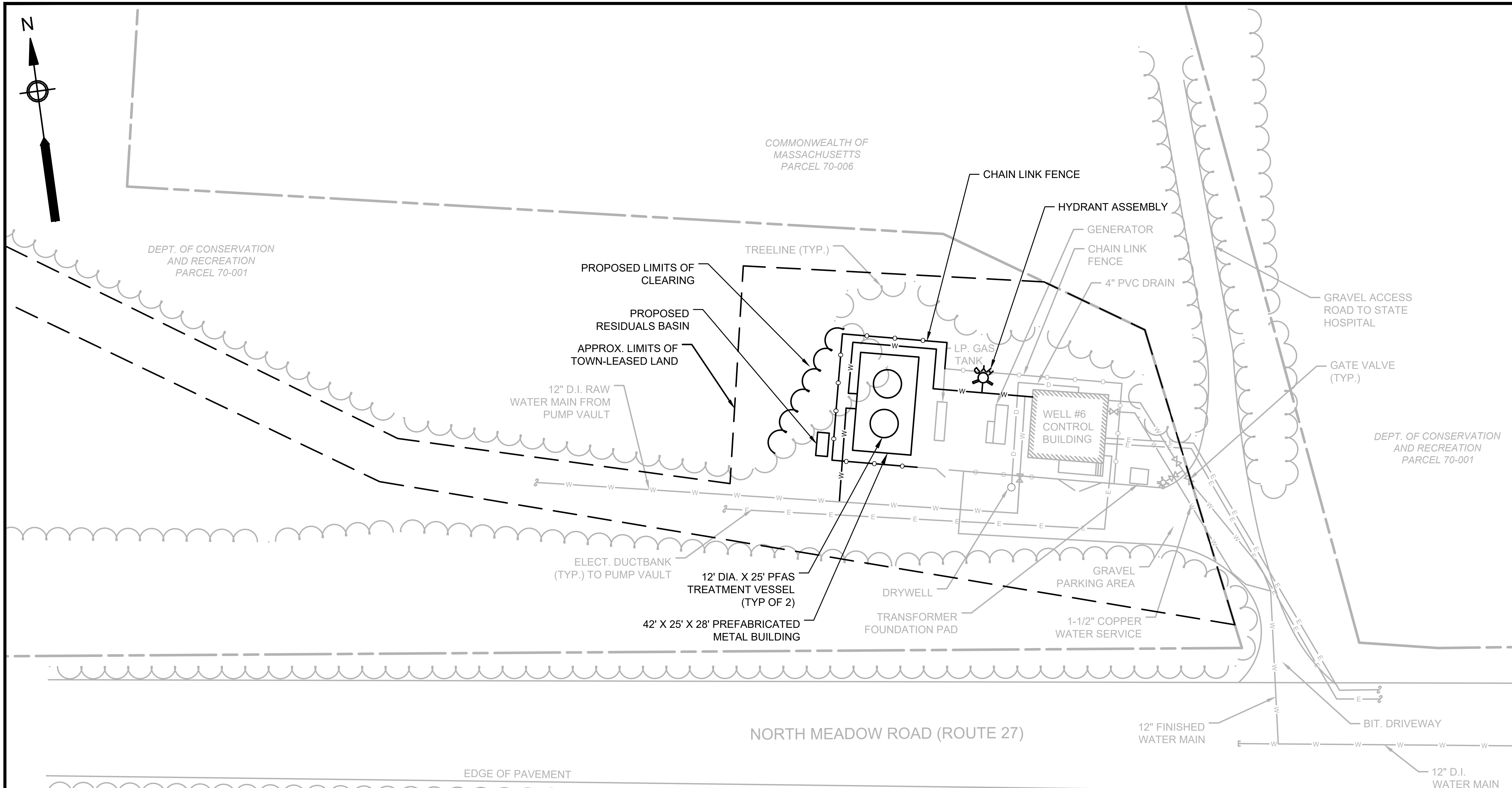
Since the nearest wastewater system is located near the intersection of Harding Street and Surry Run, approximately 6,900 linear feet from the Well 6 site, the anticipated cost associated with this backwash waste disposal option is not considered feasible but can be re-evaluated at the request of the Town. A residual basin will be constructed on the Well 6 site and be sized based on the maximum required backwash flowrate to minimize its footprint. Backwash wastewater will infiltrate into groundwater and residual waste will require removal from the basin by means of vacuum truck and require proper disposal.

Site and System Connection Considerations

The Well 6 site is within the state-owned Charles River Reservation, and the Town maintains a leased easement from the Massachusetts Department of Natural Resources that encompasses the control building, well building, and portion of the Zone I area within the Town of Medfield. Since the Town does not own the land associated with the Well 6 site, installing a new treatment and backwash waste disposal system at this site may be more difficult than the other alternatives.

Well 6 Site - Raw Water Connection

Space was identified on northwest corner of the Well 6 site for the proposed treatment system, as presented in Figure 8. For this option, the proposed treatment system inlet and outlet piping will connect to the Well 6 raw water piping, upstream of the Well 6 pump control building. An existing gate valve on the raw water main between the inlet and outlet connection points will control the flow direction. Sodium hypochlorite and sodium hydroxide will be added downstream of the treatment system at the existing chemical injection points, located within the Well 6 pump control building, to ensure chemical concentrations are not affected by the GAC.



NOTES:

1. INFORMATION BASED ON TOWN RECORD DRAWINGS, TOWN GIS, MASSGIS, AND FIELD MEASUREMENTS.

PLAN

SCALE: 1" = 40'

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ENVIRONMENTAL PARTNERS — An Apex Company —

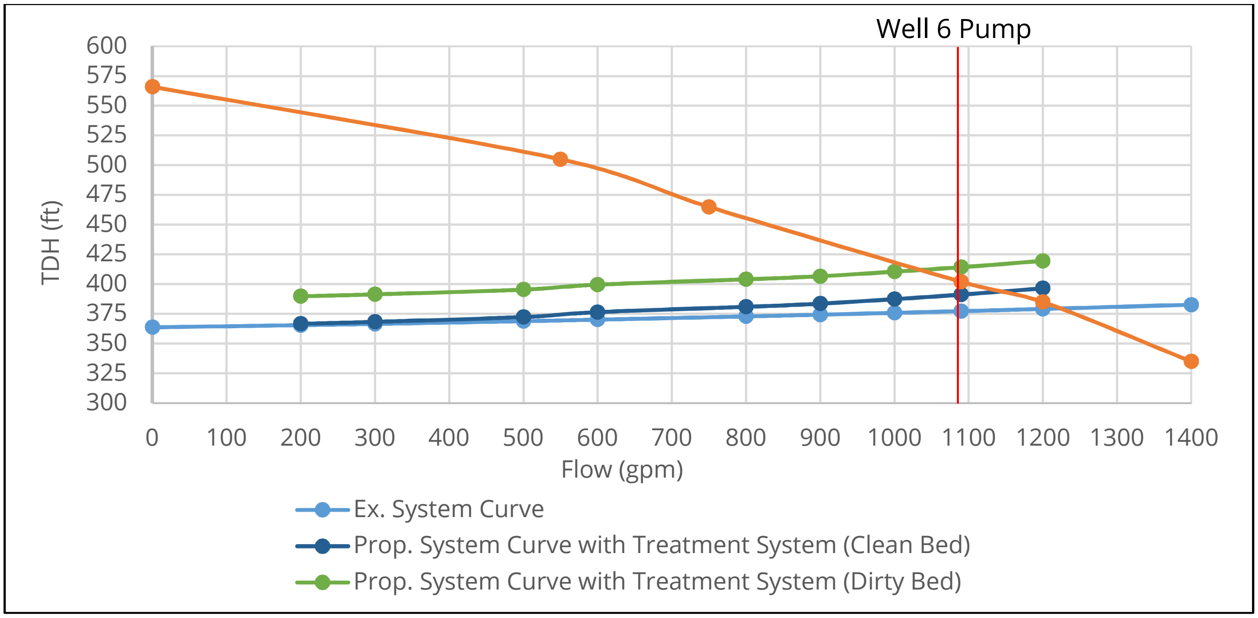
TOWN OF MEDFIELD 1651

AUGUST 2022	PFAS CONCEPTUAL DESIGN TOWN OF MEDFIELD, MASSACHUSETTS
134-2102	FIGURE 8: WELL 6 SITE PLAN AND YARD PIPING RAW WATER GAC PFAS TREATMENT EQUIPMENT

Treatment System Constraints

The Well 6 raw water well pump will be responsible for pumping water through the PFAS treatment system, which will introduce additional head loss to the system. The raw water system hydraulics were evaluated to assess if the existing raw water well pumps could accommodate the added head loss at a flow rate of 1,100 gpm. Figure 9 presents the existing and proposed raw water well pump system curves compared to the current pump curves for Well 6 raw water well pump.

Figure 9 – Well 6 Pump and System Curve



Note: A 10 psi increase in head loss through the treatment system is used between the clean bed and dirty bed.

As shown in this figure, the existing pump will accommodate the additional head loss introduced by the treatment system for the clean filter bed. However, the well pump will not be able to pump the required flow through the dirty filter bed, and therefore must be upgraded to meet the proposed operating condition.

Table 8 provides the initial design parameters for the proposed replacement Well 6 pump.

Table 8 – Proposed Well 6 Pump Design Parameters

Parameter	Value
Pump Type	Submersible Well Pump
Flow Capacity (gpm)	1,100
Head (feet)	410
Motor Size (HP)	175

Further evaluation of the existing pumps and additional headloss associated with the proposed PFAS treatment system is required during the Preliminary Design to verify if the existing pumps can be re-used. EP recommends performing a pump test to confirm the existing finished water pumping capacities and system pressures. The detailed hydraulic analysis will be based on the current pumping system operating range and proposed flow conditions to efficiently operate the treatment system.

Required Modifications

Modifications to the existing pump systems and site to implement PFAS treatment for Well 6 includes the following:

- Verify land use and lease modifications required for additional construction at Well 6 site.
- Construct new PFAS treatment building to house the GAC filtration vessels.
- Install influent/effluent PFAS treatment piping from the existing Well 6 raw water main.
- Remove and replace existing well pump.
- Construct new residual basin for backwash waste disposal.
- Install new chain link fence around new treatment area.
- Restore disturbed area around new treatment area.
- Replace existing motor control cabinet and MTS with a 400 amp main distribution panel.
- Replace VFD and connect to new service.
- Install 200-amp feeder dedicated to the PFAS treatment area.
- Install power distribution equipment for all proposed equipment in the PFAS treatment area.
- Upgrade power distribution equipment for new well pump.
- Install normal and emergency lighting systems in the PFAS treatment area.
- Install heating and ventilation systems in the PFAS treatment area to maintain customary air temperature and quality.
- Install floor drains in the PFAS treatment area and route flow to new residual basin.
- Replace well station lighting system including emergency lighting battery unit.
- Complete any additional improvements, as directed by the Town.

PERMITTING

The planning and conceptual engineering scope of work also included an evaluation of regulatory permitting requirements. In addition to complying with state building codes and other local ordinances, permitting for the permanent treatment system may include the following applications/approvals:

- MassDEP BRP WS 25 - Treatment Facility Modification
- Massachusetts Historical Commission
- Local approvals
    - Planning/Zoning Board
    - Board of Health
    - Fire Department
    - Stormwater
- Wetlands Protection Act Notice of Intent (NOI)

PROCUREMENT

The procurement of the permanent treatment system will require two separate contracts, the first of which can be performed concurrently with the preparation of construction documents for the second contract:

1. Pre-procure or purchase the GAC vessels to reduce overall construction schedule.
2. Construction contract with General Contractor to complete site work; PFAS treatment building/area construction; PFAS treatment system installation; piping modifications; mechanical, electrical, and plumbing work; start-up and training; and all appurtenances required to provide a fully operational treatment system.

Both contracts will be bid using the standard Massachusetts public bidding process. Equipment procurement could be bid under Massachusetts General Law (MGL) Chapter 30B and the PFAS facility construction would need to be bid under MGL Chapter 149.

ADDITIONAL DESIGN CONSIDERATIONS

Following the Town's review of this Conceptual Design Memorandum, the following items will need to be addressed in order to proceed with design of the PFAS treatment system for Wells 1 and 2, and/or Well 6:

- Finalize PFAS treatment system connections.
- Finalize PFAS treatment vessels pre-procurement approach.
- Finalize PFAS system backwash waste disposal approach.
- Perform a pump test on the existing Well 1, 2, and 6 raw water well pumps to confirm system pressures and pumping capacities.
- Perform a pump test on the existing Well 1 and 2 finished water pumps to confirm system pressures and pumping capacities.
- Complete code review to determine requirements for the new treatment system structure.
- Review Well 6 lease land use conditions to confirm if expanding the existing well station is covered within the existing lease agreement. EP recommends consulting with the Town's legal counsel for review of the existing lease agreement and land use conditions.

PRELIMINARY OPINION OF PROBABLE COST ESTIMATE

Based on the design approaches outlined above for the Well 1, 2, and 6 treatment connection options, the opinion of probable construction cost (OPCC) developed in August 2022 for each option is as follows:

- Well 1 Site – Aerated Water Connection: $4.02M
- Well 2 Site – Raw Water Connection: $4.35M
- Well 2 Site – Aerated Water Connection: $4.17M
- Well 6 Site – Raw Water Connection: $3.38M

A detailed opinion of probable construction cost for each option is provided as an attachment.

Due to COVID-19, potential materials and labor shortages could affect contractor pricing and impact material deliveries. The assigned OPCC contingency took these issues into consideration.

Expected markups utilized in the OPCC include the following:

- Contractor's general conditions = 7.5% of construction cost subtotal
- General contractor overhead and profit = 10% of construction cost subtotal
- Bonds and insurance = 2% of construction cost subtotal
- Design and construction contingency = 40% of OPCC
- Escalation to bid (2023) = 10% of OPCC
- Construction phase engineering services = 20% of OPCC

ATTACHMENT 2

PFAS Treatment Siting Plans

ATTACHMENTS

1. Opinion of Probable Construction Cost – August 2022
2. PFAS Treatment Siting Plans
3. Well Station Fact Sheets
4. Electrical Assessment Report – Well 1, 2 and 6 PFAS Treatment – June 2022

ATTACHMENT 1

Opinion of Probable Construction Cost – August 2022

Medfield PFAS Treatment

August 2022

Item #	Description	Units	Quantity	Unit Cost	Extended Cost
Opinion of Probable Cost: Well 1 Site - Aerated Water Connection					
	General				
1	Contractor's General Condition @ 7.5%	LS	1	$ 142,700.00	$ 142,700.00
2	General Contractors Overhead and Profit @ 10%	LS	1	$ 190,100.00	$ 190,100.00
3	Bonds and Insurance @ 2%	LS	1	$ 38,000.00	$ 38,000.00
4	Mobilization and Demobilization @ 5%	LS	1	$ 95,100.00	$ 95,100.00
	Site Work				
5	Site Grading	CY	150	$ 60.00	$ 9,000.00
6	Chain Link Fence	LF	0	$ 50.00	$ -
7	8" Water Main	LF	80	$ 180.00	$ 14,400.00
8	6" Water Main	LF	10	$ 120.00	$ 1,200.00
9	6" Gate Valve	EA	1	$ 4,000.00	$ 4,000.00
10	Hydrant Assembly	EA	1	$ 5,000.00	$ 5,000.00
11	4" PVC Force Main	LF	1,200	$ 150.00	$ 180,000.00
	Building and Pump Station				
12	Prefabricated Metal Building	LS	1	$ 500,000.00	$ 500,000.00
13	Backwash Pump Station	LS	1	$ 80,000.00	$ 80,000.00
	Process Upgrades				
14	GAC System (Vessels, Media, Piping)	LS	1	$ 710,000.00	$ 710,000.00
15	GAC System Freight (30%)	LS	1	$ 213,000.00	$ 213,000.00
	Mechanical and Electrical				
16	Electrical Upgrades	LS	1	$ 100,000.00	$ 100,000.00
17	Finished Water Pump Upgrades	EA	2	$ 40,000.00	$ 80,000.00
	SCADA and Instrumentation				
17	Instrumentation Upgrades and Programming	LS	1	$ 5,000.00	$ 5,000.00
				Subtotal	$ 2,367,500.00
				Engineering (20%)	$ 473,500.00
				Contingency (40%)	$ 947,000.00
				Escalation to Bid - 2023 (10%)	$ 236,700.00
				Total Construction Cost	**$ 4,024,700.00**

Medfield PFAS Treatment

August 2022

Opinion of Probable Cost: Well 2 Site - Raw Water Connection					
Item #	Description	Units	Quantity	Unit Cost	Extended Cost
	General				
1	Contractor's General Condition @ 7.5%	LS	1	$ 154,300.00	$ 154,300.00
2	General Contractors Overhead and Profit @ 10%	LS	1	$ 205,800.00	$ 205,800.00
3	Bonds and Insurance @ 2%	LS	1	$ 41,200.00	$ 41,200.00
4	Mobilization and Demobilization @ 5%	LS	1	$ 102,900.00	$ 102,900.00
	Site Work				
5	Site Grading	CY	150	$ 60.00	$ 9,000.00
6	Chain Link Fence	LF	65	$ 50.00	$ 3,250.00
7	8" Water Main	LF	60	$ 180.00	$ 10,800.00
8	6" Water Main	LF	10	$ 120.00	$ 1,200.00
9	6" Gate Valve	EA	1	$ 4,000.00	$ 4,000.00
10	Hydrant Assembly	EA	1	$ 5,000.00	$ 5,000.00
11	4" PVC Force Main	LF	1,600	$ 150.00	$ 240,000.00
	Building and Pump Station				
12	Prefabricated Metal Building	LS	1	$ 500,000.00	$ 500,000.00
13	Backwash Pump Station	LS	1	$ 80,000.00	$ 80,000.00
	Process Upgrades				
14	GAC System (Vessels, Media, Piping)	LS	1	$ 630,000.00	$ 630,000.00
15	GAC System Freight (30%)	LS	1	$ 189,000.00	$ 189,000.00
	Mechanical and Electrical				
16	Electrical Upgrades	LS	1	$ 100,000.00	$ 100,000.00
17	Well Pump	EA	2	$ 100,000.00	$ 200,000.00
18	Finished Water Pump Upgrades	EA	2	$ 40,000.00	$ 80,000.00
	SCADA and Instrumentation				
17	Instrumentation Upgrades and Programming	LS	1	$ 5,000.00	$ 5,000.00
				Subtotal	$ 2,561,450.00
				Engineering (20%)	$ 512,200.00
				Contingency (40%)	$ 1,024,500.00
				Escalation to Bid - 2023 (10%)	$ 256,200.00
				Total Construction Cost	**$ 4,354,350.00**

Medfield PFAS Treatment

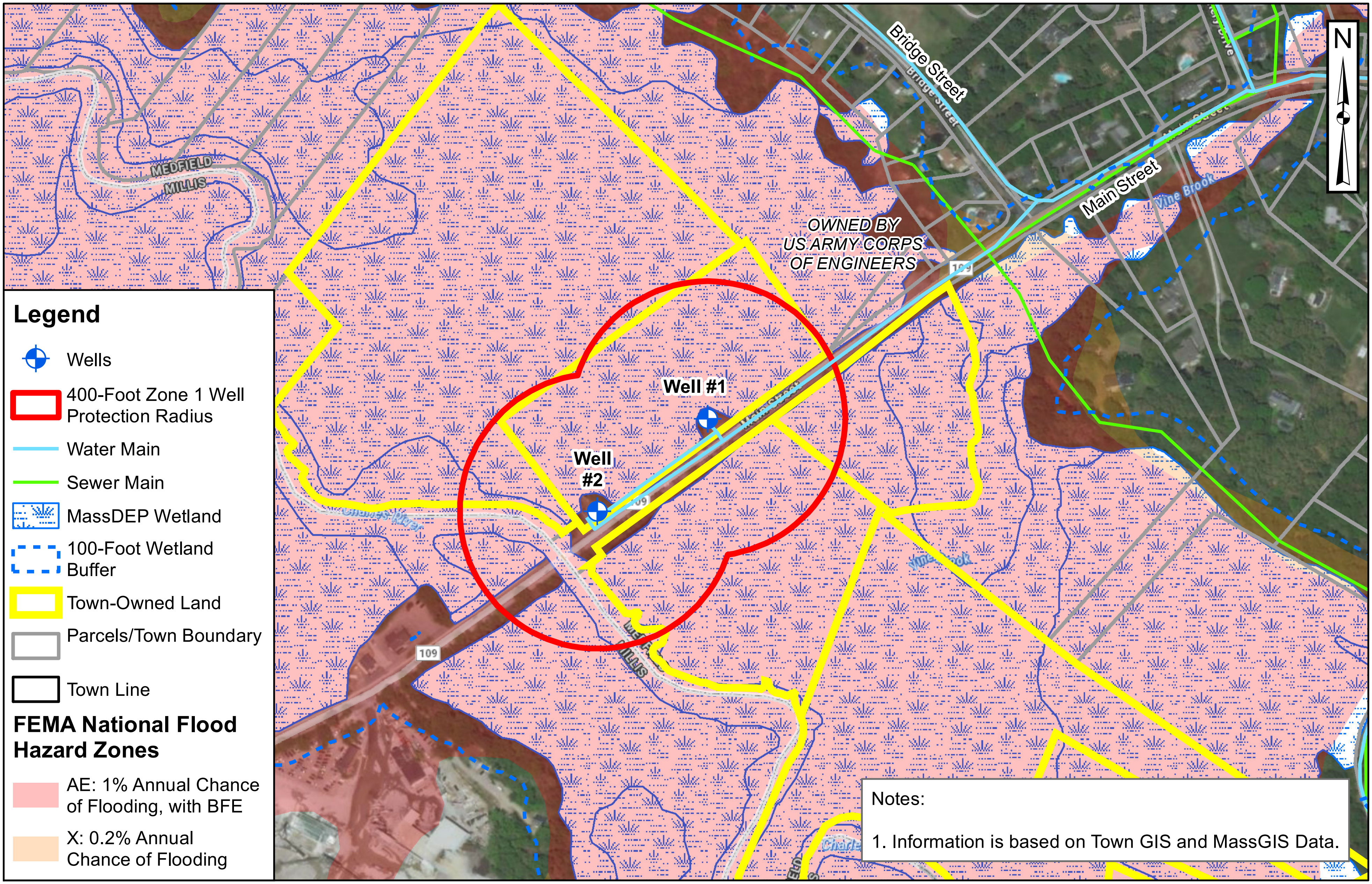
August 2022

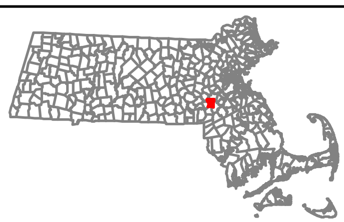
Opinion of Probable Cost: Well 2 Site - Aerated Water Connection					
Item #	Description	Units	Quantity	Unit Cost	Extended Cost
	General				
1	Contractor's General Condition @ 7.5%	LS	1	$ 147,700.00	$ 147,700.00
2	General Contractors Overhead and Profit @ 10%	LS	1	$ 196,800.00	$ 196,800.00
3	Bonds and Insurance @ 2%	LS	1	$ 39,300.00	$ 39,300.00
4	Mobilization and Demobilization @ 5%	LS	1	$ 98,500.00	$ 98,500.00
	Site Work				
5	Site Grading	CY	150	$ 60.00	$ 9,000.00
6	Chain Link Fence	LF	70	$ 50.00	$ 3,500.00
7	8" Water Main	LF	100	$ 180.00	$ 18,000.00
8	6" Water Main	LF	10	$ 120.00	$ 1,200.00
9	6" Gate Valve	EA	1	$ 4,000.00	$ 4,000.00
10	Hydrant Assembly	EA	1	$ 5,000.00	$ 5,000.00
11	4" PVC Force Main	LF	1,600	$ 150.00	$ 240,000.00
	Building and Pump Station				
12	Prefabricated Metal Building	LS	1	$ 500,000.00	$ 500,000.00
13	Backwash Pump Station	LS	1	$ 80,000.00	$ 80,000.00
	Process Upgrades				
14	GAC System (Vessels, Media, Piping)	LS	1	$ 710,000.00	$ 710,000.00
15	GAC System Freight (30%)	LS	1	$ 213,000.00	$ 213,000.00
	Mechanical and Electrical				
16	Electrical Upgrades	LS	1	$ 100,000.00	$ 100,000.00
17	Finished Water Pump Upgrades	EA	2	$ 40,000.00	$ 80,000.00
	SCADA and Instrumentation				
17	Instrumentation Upgrades and Programming	LS	1	$ 5,000.00	$ 5,000.00
				Subtotal	$ 2,451,000.00
				Engineering (20%)	$ 490,200.00
				Contingency (40%)	$ 980,400.00
				Escalation to Bid - 2023 (10%)	$ 245,100.00
				Total Construction Cost	**$ 4,166,700.00**

Medfield PFAS Treatment

August 2022

Opinion of Probable Cost: Well 6 Site - Raw Water Connection					
Item #	Description	Units	Quantity	Unit Cost	Extended Cost
	General				
1	Contractor's General Condition @ 7.5%	LS	1	$ 119,700.00	$ 119,700.00
2	General Contractors Overhead and Profit @ 10%	LS	1	$ 159,700.00	$ 159,700.00
3	Bonds and Insurance @ 2%	LS	1	$ 32,000.00	$ 32,000.00
4	Mobilization and Demobilization @ 5%	LS	1	$ 79,900.00	$ 79,900.00
	Site Work				
5	Site Grading	CY	150	$ 60.00	$ 9,000.00
6	Chain Link Fence	LF	50	$ 50.00	$ 2,500.00
7	8" Water Main	LF	150	$ 180.00	$ 27,000.00
8	6" Water Main	LF	10	$ 120.00	$ 1,200.00
9	6" Gate Valve	EA	1	$ 4,000.00	$ 4,000.00
10	Hydrant Assembly	EA	1	$ 5,000.00	$ 5,000.00
11	Residual Basin	LS	1	$ 20,000.00	$ 20,000.00
	Building and Pump Station				
12	Prefabricated Metal Building	LS	1	$ 500,000.00	$ 500,000.00
	Process Upgrades				
13	GAC System (Vessels, Media, Piping)	LS	1	$ 710,000.00	$ 710,000.00
14	GAC System Freight (30%)	LS	1	$ 213,000.00	$ 213,000.00
	Mechanical and Electrical				
15	Electrical Upgrades	LS	1	$ 100,000.00	$ 100,000.00
	SCADA and Instrumentation				
16	Instrumentation Upgrades and Programming	LS	1	$ 5,000.00	$ 5,000.00
				Subtotal	$ 1,988,000.00
				Engineering (20%)	$ 397,600.00
				Contingency (40%)	$ 795,200.00
				Escalation to Bid - 2023 (10%)	$ 198,800.00
				Total Construction Cost	**$ 3,379,600.00**





Wells 1 and 2 Site Area
Wells 1, 2 & 6 PFAS Conceptual Design
Medfield, Massachusetts
August 2022

0 250 500
Feet

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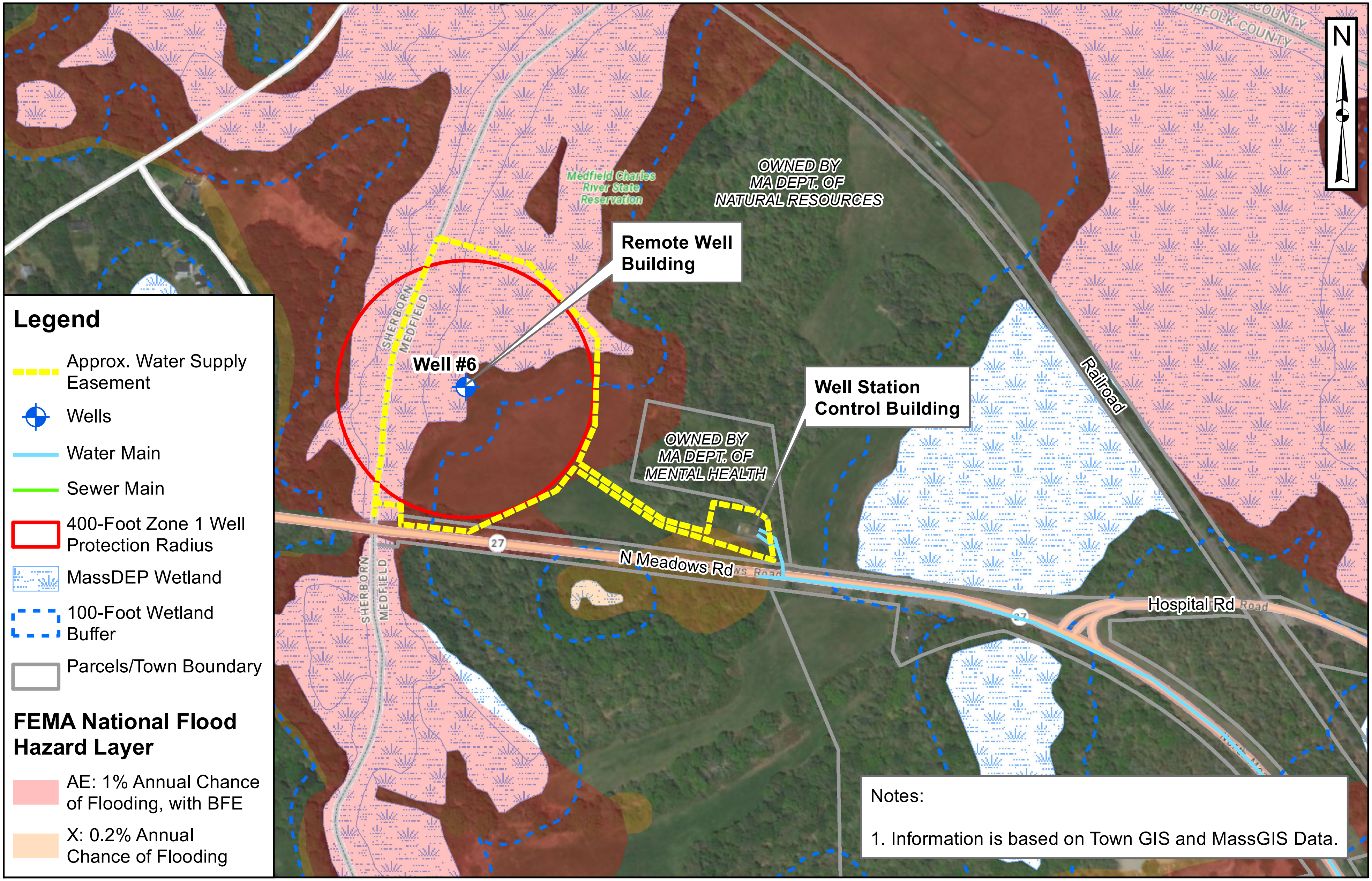

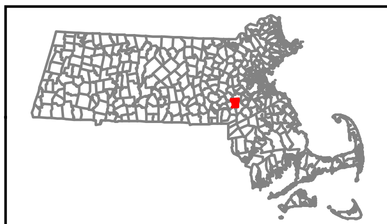

Well 6 Site Area
Wells 1, 2 & 6 PFAS Conceptual Design
Medfield, Massachusetts
August 2022

0 250 500 Feet

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ATTACHMENT 3

Well Station Fact Sheets

ENVIRONMENTAL PARTNERS
— An Apex Company —

WELLS 1, 2 & 6 - PFAS TREATMENT FEASIBILITY STUDY

TOWN OF MEDFIELD, MA

Well 1 – Fact Sheet

Site:

- Located on Town owned land.
- Pump building houses the well, chemical feed system, and all associated process mechanical, control and electrical equipment.
- Sodium hydroxide bulk tank located behind building and surrounded by security fence.
- Asphalt driveway in front of pump building.
- Site surrounded by wetlands to the north, east, and west; and Main Street to the south.

Well 1 Site and Pump Building

System Description:

- Raw water is pumped to Well 2 site for aeration (aeration tower) and temporary storage (clearwell).
- Blended aerated water is pumped from Well 2 clearwell back to Well 1 for chemical addition (sodium hypochlorite and sodium hydroxide).
    - Currently only sodium hypochlorite is used for treatment.
- Sodium hypochlorite is added at water main in front of Well 1 building.

Well 1 Pump Building - Interior

Pump System and Hydraulics:

- Well 1 pumps to aeration tower inlet. Pump originally sized to pump directly to distribution.
- Existing vertical turbine well pump rated for 300 gpm @ 321-ft TDH.
    - Existing well pump is capable of pumping through PFAS treatment system.
- System hydraulic gradeline: Elev. 360-ft (NGVD88) – Hospital Road Tank overflow elevation.

Water Quality:

- PFAS: Well 1 & 2 finished water (Blend) sampling indicates source is nearing MCL (20 ng/L).
- VOC: Present in raw water, treated via aeration tower.

Treatment System Design Constraints:

- Limited space available at Well 1 site for new PFAS treatment system.
- Sewer pump station and force main would be required for backwash waste removal.
- Site is located adjacent to wetlands and within wetland buffer zones.
- Site is located within the 100-yr flood plain.
- Zoning Board setback requirements for new treatment system building.

ENVIRONMENTAL PARTNERS
— An Apex Company —

WELLS 1, 2 & 6 - PFAS TREATMENT FEASIBILITY STUDY

TOWN OF MEDFIELD, MA

Well 2 – Fact Sheet

Site:

- Located on land owned by the Town of Medfield.
- Pump building houses process mechanical, control and electrical equipment.
- Well 2 located outside pump building.
- Site includes aeration tower and clearwell.
- Well 1 & 2 finished water pumps and piping are located below pump building.
- Site is surrounded by security fence.
- Site surrounded by wetlands to the north, east, and west; and Main Street to the south.

Well 2 Site and Pump Building

System Description:

- Raw water is pumped to aeration tower and temporarily stored in the on-site clearwell.
- Blended aerated water is pumped from Well 2 clearwell back to Well 1 for chemical addition (sodium hypochlorite and sodium hydroxide).
  - Currently only sodium hypochlorite is used for treatment.
- Sodium hypochlorite is added at water main in front of Well 1 building.

Well 2 Submersible Well Pit

Pump System and Hydraulics:

- Well 2 pumps to aeration tower inlet.
- Existing submersible well pump rated for 600 gpm @ 116-ft TDH (2019 pump test measured TDH of 342' @ 600 gpm). Need to confirm pump capacity and head.
- System hydraulic gradeline: Elev. 360-ft (NGVD88) – Hospital Road Tank overflow elevation.

Water Quality:

- PFAS: Well 1 & 2 finished water (Blend) sampling indicates source is nearing MCL (20 ng/L).
- VOCs: Present in raw water, treated vis aeration tower.

Treatment System Design Constraints:

- Limited space available at Well 2 site for new PFAS treatment system.
- Sewer pump station and force main would be required for backwash waste removal.
- Site is located adjacent to wetlands and within wetland buffer zones.
- Site is located within the 100-yr flood plain.
- Zoning Board setback requirements.

ENVIRONMENTAL PARTNERS
— An Apex Company —

WELLS 1, 2 & 6 - PFAS TREATMENT FEASIBILITY STUDY

TOWN OF MEDFIELD, MA

Well 6 – Fact Sheet

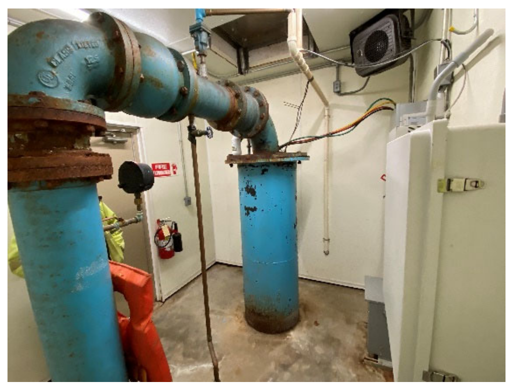
Site:

- Located on land owned by the Department of Conservation and Recreation (DCR) and leased to the Town.
- Remote pump building houses the well and control building houses piping, chemical and control equipment.
- Control building site includes generator and propane tank for standby power.
- Land owned by the Comm. of Massachusetts is located directly to the north of the control building site. North Meadow Road is located to south.
- Charles River is located directly west of remote well site.
- Control building site is surrounded by security fence.

Well 6 Control Building and Site

System Description:

- Raw water is pumped from remote well site to control building for chemical addition (sodium hypochlite and sodium hydroxide).



Well 6 Remote Pump Buiding - Interior

Pump System and Hydraulics:

- Submersible well pump rated for 1,100 gpm @ 402-ft TDH.
- System hydraulic gradeline: Elev. 360-ft (NGVD88) – Hospital Road Tank overflow elevation.
- Well 6 pumps directly to distribution system.

Water Quality:

- PFAS: Well 6 finished water sampling indicates source is below MCL (<10 ng/L).

Treatment System Design Constraints:

- Limited space available at control building site for new PFAS treatment system.
- Town does not own land. Modification to leased land area may be required.
- Zoning Board setback requirements for new treatment system building.

ATTACHMENT 4

Electrical Assessment Report

SAR Engineering, Inc.

ELECTRICAL ASSESSMENT REPORT

TOWN OF MEDFIELD
WELLS 1, 2 AND 6 PFAS TREATMENT

AUGUST, 2022

PREPARED BY:

SAR Engineering, Inc.
150 Grossman Drive, Suite 309
Braintree, MA
617-221-9220

Project No. 22007.00

I. Well Station #1

A. Power System

1. The Well Station receives 480 Volt, 3-phase, 3-wire, 100 Amp power from Well #2 Station's Motor Control Center via an underground duct bank that connects to the station's main fused disconnect switch (MFDS) located in the Well Station.

2. The Well Station does not have an on-site generator, refer to Well Station #2 below for generator backup power.

3. The MFDS provides power to a wall mounted open type variable frequency drive (VFD) which provides start/stop and speed control of the well pump.

4. The MFDS also provides power to a 120/240 Volt panelboard via a 15KVA transformer. The panelboard provides power to lights, receptacles, chemical feed systems, the SCADA panel, and miscellaneous equipment.

5. The power system equipment with exception of the VFD appears to be over 40 years old, is in poor condition, and is past its useful life of 30 years. The VFD appears to be about 10 years old and is approaching its useful life of 10 to 12 years.

B. Lighting System

1. The interior lighting consisted of surface mounted canopy type down light fixtures utilizing screw in base LED bulbs.

2. The station did not have code required emergency egress lighting.

3. The fixtures appear to be in fair to poor condition and are over 40 years old.

C. Recommendations

1. Remove the complete electrical power system and replace with a new 480 Volt Main Panelboard (MPB), a 120/208 Volt panelboard with associated 15KVA transformer, new receptacles, conduit, wiring, and ect.

2. A new VFD powered from the MPB would be provided for the 40HP Well Pump.

3. The MPB would provide 480V, 3-phase power to an electric unit heater and the 15KVA transformer.

4. Replace the light system completely with surface mounted linear vapor tight LED light fixtures and new local switch control.

5. A new emergency lighting battery unit would be provided.

II. Well Station #2

A. Power System

1. The Well Station receives 480 Volt, 3-phase, 3-wire, 400 Amp utility power from a pole mounted utility transformer with primary metering. The transformer's secondary power feeds into the well station via an underground duct bank and connects to the station's Main Circuit Breaker (MCB) mounted in a motor control center (MCC) located in the Well Station's Electrical Room.

2. The Well Station does not have an on-site generator and receives backup generator power via a portable generator that would connect into a manual transfer switch (MTS) located in the Well Station's Electrical Room. The MTS load side connects to the MCC via a 400 Amp circuit breaker that is kirk keyed interlock with the MCB main circuit breaker. The MTS did not have any exterior provisions for generator connections, generator connections would require the Well Station's Door and the MTS door to remain open to allow the generator cables to be connected to the MTS.

3. The MCC is a 480 Volt, 3-phase, 3-wire, 600 Amp motor control center that contains the 400 Amp MCB, a Well Pump feeder circuit breaker, a Well #1 feeder circuit breaker, motor starters, 30KVA transformer, and a 120/208 Volt panelboard. The motor starters provide power to (3) Finished Water Pumps and a Blower.

4. A wall mounted open type variable frequency drive (VFD) provides start/stop and speed control of the well pump.

5. The MCC mounted 120/208 Volt panelboard provides power to lights, receptacles, chemical feed systems, the SCADA panel, and miscellaneous equipment.

6. The power system equipment with exception of the VFD appears to be over 25 years old, is in fair to good condition, and is approaching its useful life of 30 years. The VFD appears to be less than 10 years old and is approaching its useful life of 10 to 12 years.

7. Taking into account the replacement of the existing Finished Water Pumps with two 100HP pumps the Well Station will have a total connected load of

239KW, a demand load of 191KW, and 22KW of spare demand load capacity. The new PFAS Treatment Building will have estimated connected load of 40KW with demand load of 31KW. The Well Station's spare demand load capacity does not have the capacity to power the new PFAS Treatment Building and will require a service upgrade.

B. Lighting System

1. The interior lighting in the Electric Room and the Pump Room consisted of surface mounted linear industrial lensed fluorescent light fixtures.

2. An emergency lighting battery unit is located in the Electric Room and one in the Pump Room which provides the code required emergency egress lighting.

3. The fixtures appear to be in fair condition, over 25 years old, and have older less efficient fluorescent lamps.

C. Recommendations

1. Upgrade the existing electrical service to a 277/480 Volt, 600 Amp, 3-phase, 4-wire service that is metered on the secondary side of the utility transformer.

2. Due to age and service being undersized remove the existing MCC and MTS and replace them with a 600 Amp Main Circuit Breaker (MCB), a 600 Amp MTS, and a 600 Amp Main Distribution Board (MDP). The MCB shall be connected to the MTS which will provide power to the MDP, a Generator Docking Station shall be mounted on the exterior of the Well Station and will be connected to the emergency side of the MTS.

3. New VFDs powered from the MDP would be provided for the 25HP Well Pump and the (2) 100HP Finished Water Pumps. An enclosed motor starter powered from MDP would be provided for the Blower.

4. The MDP would provide 100 Amp, 480V, 3-phase power to the new PFAS treatment building.

5. The MDP would provide 100 Amp, 480V, 3-phase power to Well Station #1.

6. The MDP would provide 480V, 3-phase power to electric unit heaters.

7. The MDP would provide 480V, 3-phase power to a new 120/208 Volt panelboard via a 15KVA transformer.

8. Due to utilizing florescent bulbs, replace the existing lights with surface mounted linear vapor tight LED light fixtures.

9. Due to age, replace the emergency lighting battery units.

III. Well Station #6

A. Power System

1. The well station receives 277/480 Volt, 3-phase, 4-wire, 400 Amp utility power from a pad mounted utility transformer. The transformer's secondary power feeds into the well station via an underground duct bank and connects to the station's Main Circuit Breaker (MCB) located in the Well Station. The load side of MCB is connected to a 400 Amp automatic transfer switch via a utility metering cabinet.

2. The well station receives generator power from an exterior 180 KW Katolight propane gas engine generator set. The generator power feeds into the ATS which provides power to a motor control center (MCC)

3. The MCC is a 277/480 Volt, 3-phase, 4-wire, 600 Amp motor control center that contains the well pump soft starter, 30KVA transformer, and a 120/208 Volt panelboard. The soft starter has been bypassed to a variable frequency drive (VFD) located at the well and provides start/stop and speed control of the well pump.

4. The MCC mounted 120/208 Volt panelboard provides power to lights, receptacles, chemical feed systems, the SCADA panel, and miscellaneous equipment.

5. The power system equipment including the appear to be approximately 15 to 20 years old, is in good condition, and has about of 10 years of its useful life remaining.

6. Taking into account the replacement of the existing Well Pump with a 175HP pump the Well Station will have a total connected load of 146KW, a demand load of 116KW, and 34KW of spare demand load capacity. The new PFAS Treatment Building will have estimated connected load of 20KW with demand load of 16KW. The Well Station's spare demand load capacity does have the capacity to power the new PFAS Treatment Building.

B. Lighting System

1. The interior consisted of surface mounted linear industrial lensed fluorescent light fixtures.

2. Emergency lighting battery unit provide the code required emergency egress lighting.

3. The fixtures appear to be in fair condition, appear to be over approximately 15 to 20 years old and have older less efficient fluorescent lamps.

C. Recommendations

1. Due to having no function except as the Well Pump feeder and housing the 120/208 Volt panelboard, the existing MCC should be removed and replaced with a 400 Amp Main Distribution Board (MDP).

2. A New VFD powered from the MDP would be provided for the 175HP Well Pump and be located in the Well Station.

3. The MDP would provide 60 Amp, 480V, 3-phase power to the new PFAS treatment building.

4. The MDP would provide 480V, 3-phase power to a new 120/208 Volt panelboard via a 15KVA transformer.

5. Due to utilizing florescent bulbs, replace the existing lights with surface mounted linear vapor tight LED light fixtures.

6. Due to age, replace the emergency lighting battery units.

END OF REPORT