Naval Facilities Engineering Systems Command

BRAC Program Management Office East
Philadelphia, Pennsylvania

Engineering Evaluation/Cost Analysis

Jordan Avenue Wellfield Drinking Water Treatment

Former Naval Air Station Brunswick
Brunswick, Maine

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ENGINEERING EVALUATION/COST ANALYSIS

JORDAN AVENUE WELLFIELD DRINKING WATER TREATMENT

FORMER NAVAL AIR STATION BRUNSWICK
BRUNSWICK, MAINE

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Department of the Navy
Base Realignment and Closure Program Management Office East
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Acronyms and Abbreviations

ARAR	Applicable or relevant and appropriate requirement
BACSE	Brunswick Area Citizens for a Safe Environment
bgs	Below ground surface
BRAC	Base Realignment and Closure
BTWD	Brunswick Topsham Water District
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-Term Environmental Action Navy
CTO	Contract Task Order
CWA	Clean Water Act
EBCT	Empty bed contact time
EE/CA	Engineering Evaluation/Cost Analysis
ft msl	feet above mean sea level
GAC	Granular activated carbon
gpm	Gallons per minute
gpm/SF	Gallons per minute per square foot
GWTS	Groundwater treatment system
HA	Health advisory
HP	Horsepower
IX	Ion exchange
JA	Jordan Avenue
lb	pounds
MEDEP	Maine Department of Environmental Protection
NASB	Naval Air Station Brunswick
Navy	United States Department of the Navy
NCP	National Contingency Plan
ng/L	Nanograms per liter

NRWQC	National recommended water quality criteria
NTCRA	Non-time-critical removal action
O&M	Operation and maintenance
OMB	Office of Management and Budget
PFAS	Per- and polyfluoroalkyl substance
PFDA	Perfluorodecanoic acid
PFHpA	Perfluoroheptanoic acid
PFHxS	Perfluorohexanesulfonic acid
PFNA	Perfluorononanoic acid
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctanesulfonic acid
PFPeA	Perfluoropentanoic acid
PPE	Personal protective equipment
QSM	Quality Systems Manual
RAWP	Removal action work plan
RAO	Removal action objective
RI	Remedial investigation
SARA	Superfund Amendments and Reauthorization Act
SF	Square foot
SOP	Standard operating procedure
TBC	To be considered
USEPA	United States Environmental Protection Agency
VOCs	Volatile organic compounds

Executive Summary

This Engineering Evaluation/Cost Analysis (EE/CA) has been prepared by Tetra Tech on behalf of the United States Department of the Navy (Navy) under the Comprehensive Long-Term Environmental Action Navy Contract No. N6247016D9008, Contract Task Order N4008518F5894, to present the development and evaluation of per- and polyfluoroalkyl substance (PFAS)-impacted drinking water removal action alternatives at the Brunswick Topsham Water District (BTWD) wellfield. Sampling performed by Brunswick Topsham Water District in December 2021 identified the presence of PFAS in some water supply wells at concentrations below United States Environmental Protection Agency (USEPA) Health Advisory (HA) levels (2016) but above Maine interim standards for community water systems and nontransient, noncommunity water systems (June 2021). The non-time critical removal action (NTCRA) has been initiated based on the detection of PFAS-impacted groundwater at the former base immediately upgradient of the PFAS-impacted wellfield, with concentrations well above the 2016 HA levels of 70 nanograms per liter (ng/L) of combined perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS). The EE/CA was conducted in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986, the National Contingency Plan (NCP), and relevant USEPA guidance.

The EE/CA process provides a recommendation for removal actions based on the evaluation of various alternatives. Preparation of this EE/CA fulfills CERCLA and the regulations in Section 300.415(b)(4)(i) of the NCP, which require that an EE/CA be prepared for all (NTCRAs) to document the removal action selection process.

The goal of this EE/CA is to develop and recommend a removal action alternative for the treatment of drinking water from the Jordan Avenue wellfield that achieves the following removal action objectives (RAOs):

- Eliminate existing and future exposure to PFOS and PFOA in drinking water in excess of the 2016 USEPA lifetime HA from the Jordan Avenue Wells.
- Support the operation of existing BTWD PFAS mitigation system until the selected removal action has been implemented.

The following three removal action alternatives were developed based on the identified RAOs, Applicable or Relevant and Appropriate Requirements (ARARs), and removal action goals:

- Alternative 1 – No Action: In accordance with the NCP, a “No Action” alternative is included in the EE/CA to provide a baseline for comparison to other removal action alternatives.
- Alternative 2 – Treatment system with granular activated carbon (GAC). This alternative would include the installation of a GAC PFAS treatment system on-site at the Jordan Avenue wellfield.
- Alternative 3 – Treatment system using only single-use ion exchange (IX) resin. This alternative would include the installation of an IX PFAS treatment system on-site at the Jordan Avenue wellfield.
- Alternative 4 – Treatment system using GAC and single-use ion exchange (IX) resin. This alternative would include the installation of an IX PFAS treatment system couple with a GAC PFAS treatment system on-site at the Jordan Avenue wellfield.

Consistent with the protocols established under the NCP and following USEPA guidance, each alternative was evaluated with respect to its effectiveness, implementability, and cost. Based on this evaluation, it is the Navy’s recommendation that for the Jordan Avenue wellfield, Alternative 4, Treatment System with GAC and IX, be selected as the removal action because it would achieve the RAOs and protect human health and the environment in a cost-effective manner while being more technically and administratively feasible than other alternatives.

1.0 Introduction

This Engineering Evaluation/Cost Analysis (EE/CA) has been prepared by Tetra Tech on behalf of the United States Department of the Navy (Navy) under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract No. N6247016D9008, Contract Task Order (CTO) N4008518F5894, to present the development and evaluation of per- and polyfluoroalkyl substance (PFAS) impacted drinking water removal action alternatives for a non-time-critical removal action (NTCRA) to be conducted at the Brunswick Topsham Water District (BTWD) Jordan Avenue (JA) wellfield adjacent to the Former Naval Air Station Brunswick (NASB) in Maine. The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and regulations in 40 Code of Federal Regulations (CFR) 300.415(b)(4)(i) of the National Contingency Plan (NCP) require that an EE/CA be prepared for all NTCRAs (USEPA, 1993). The Navy is the lead agency, with oversight from the United States Environmental Protection Agency (USEPA) and Maine Department of Environmental Protection (MEDEP), for cleanup of sites at NASB in the Installation Restoration (IR) Program under CERCLA.

Former NASB is located southeast of the City of Brunswick along the northeastern coast of the Gulf of Maine. The JA wellfield is located north of the former NASB and within a relatively low-lying area between Bath Road to the south and the Androscoggin River to the north.

The location of former NASB is shown on Figure 1-1. The site map of the JA wellfield is shown on Figure 1-2.

1.1 Purpose

This EE/CA was prepared to identify removal action objectives (RAOs) for the JA wellfield and to develop and evaluate removal action alternatives to address PFAS--impacted drinking water based on their relative effectiveness, implementability, and cost. Ultimately, this EE/CA recommends a preferred removal action which was selected from the alternatives presented.

1.2 Regulatory Context

PFOA and PFOS have been recently detected in groundwater at the former base immediately upgradient of the municipal wellfield at concentrations well above the USEPA 2016 Health Advisory (HA) of 70 nanograms per liter (ng/L). This could cause concentrations to increase in production wells to above the 2016 HA and thus increase potential risks to a potable drinking water source. Recent (December 2021 through

April 2022) PFAS sampling at the JA wellfield by BTWD detected PFAS concentrations in select well, spring, surface water, and finished water samples above the recently published State of Maine interim standard of 20 ng/L combined for six regulated PFASs (perfluorooctanoic acid [PFOA], perfluorooctanesulfonic acid [PFOS], perfluorononanoic acid [PFNA], perfluorodecanoic acid [PFDA], perfluoroheptanoic acid [PFHpA], and perfluorohexanesulfonic acid [PFHxS]) for community water systems. However, the finished water concentrations are below the 2016 USEPA HA levels of combined 70 ng/L for PFOA plus PFOS. These recent sample results are consistent with historical sampling results in this area.

In addition, per Department of Defense (DoD) Guidance on Using State Per- and Polyfluoroalkyl Substances Drinking Water Standards in Comprehensive Environmental Response, Compensation, and Liability Act Removal Actions (DoD, 2021), DoD may initiate a removal action where DoD is responsible for a confirmed release with PFOS/PFOA concentrations above the USEPA lifetime HA levels in drinking water (i.e., groundwater currently used for drinking water). Removal actions may extend to drinking water wells that are currently below the USEPA PFOS/PFOA HA levels when site specific hydrogeological conditions are expected to result in an exceedance of that level without a removal action.

1.3 Non-Time-Critical Removal Actions

There is no time restriction for implementing the removal action at the JA wellfield. A removal action is considered to be "non-time-critical" when the planning period from the time a removal action was determined to be necessary to the time when the removal action will be initiated is greater than 6 months. Since this removal action has been designated non-time-critical, the start date is dependent on completion of public review and subsequent Action Memorandum, the availability of adequate funding and contracting actions. Once the planning and approval process is complete, the removal action can be implemented. While this removal action is classified as non-time-critical, the Navy is making significant efforts to accelerate initiation of this action.

Aside from the previously mentioned dependence upon timely regulatory approval of the Action Memorandum, and adequate funding and contracting availability, there are no other anticipated weather-related restrictions, administrative restrictions, nor are there any material availability restrictions that are expected to impact the removal schedule.

1.4 Report Organization

The remaining six sections of this EE/CA are organized as follows:

- **Section 2.0, Site Characterization** – This section provides a summary of the setting and background; previous removal actions; and the source, nature, and current extent of PFAS-impacted groundwater at JA wellfield; and presents a summary of the analytical data available and the streamlined risk evaluation process.
- **Section 3.0, Identification of Removal Action Objectives** – This section presents the RAOs developed for the JA wellfield and provides removal estimates along with the cleanup goals and Applicable or Relevant and Appropriate Requirements (ARARs).
- **Section 4.0, Identification of Potential Removal Actions and System Configurations** – This section This section presents the potential removal action remedial technologies as well as system configurations for the JA wellfield.
- **Section 5.0, Identification and Analysis of Removal Action Alternatives** – This section presents the analysis of the removal action alternatives evaluated with regard to their effectiveness, implementability, and cost.
- **Section 6.0, Comparative Analysis of Removal Action Alternatives** – This section compares the results of the analyses of each of the removal action alternatives from Section 4.0 with regard to their effectiveness, implementability, and cost.
- **Section 7.0, Recommended Removal Action Alternative** – This section summarizes the recommended removal action alternative based on the analyses presented in Sections 4.0 and 5.0.
- **Section 8.0, References** – This section provides a list of the documents referenced in this EE/CA.

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2.0 Site Characterization

This section provides a description of the background and setting for the JA wellfield along with a summary of previous investigations and the source, nature, and extent of PFAS-impacted groundwater.

2.1 Site Description and Background

The former NASB is located in Brunswick, Cumberland County, Maine, south of the Androscoggin River and south of Route 1 between Routes 24 and 123 (Figure 1-2). The base supported the Navy's antisubmarine warfare operations in the Atlantic Ocean with several squadrons of P-3 maritime patrol aircraft. NASB was selected in 2005 by the Base Realignment and Closure (BRAC) Commission for closure and was deactivated on May 31, 2011. The base population and facility operations decreased significantly with the end of the base's flying mission in January 2010. More than 80 percent of the former base has been transferred out of Navy ownership since base closure, and redevelopment activities are ongoing, including the opening of a civilian airport (Brunswick Executive Airport), a business and industrial park (Brunswick Landing), and residential development.

The former base occupied approximately 3,094 acres, and the operational area covered approximately 138 acres east of the two parallel runways extending north to south in the northern portion of the facility. The operational area included numerous office buildings, barracks, recreational facilities, hangars, repair shops, and other facilities that formerly supported NASB aircraft, although building demolition associated with base closure and redevelopment is ongoing. Forested areas, grasslands, shrubland, marsh, and open water comprise approximately 83 percent of the base, with the remaining 17 percent consisting of paved areas (primary flight ramps and runways) of the operations area. The southern edge of the base borders coves and estuaries of the Gulf of Maine.

The JA wellfield is located within a relatively low-lying area between Bath Road to the south and the Androscoggin River to the north. Land surface in the Bath Road area is at an elevation of approximately 60 feet above mean sea level (ft msl), sloping down to about 10 ft msl in the wellfield area. The wellfield consists of 138 shallow, small-diameter wells (Figure 1-2) that withdraw groundwater from a thin sand and gravel layer (averaging about 10 feet thick) that is locally present between overlying finer grained (fine to medium silty sand) deposits and an underlying clay and fine sand deposit. The sand and gravel layer is hydraulically connected to the nearby Androscoggin River.

A number of springs exist south and southeast of the wellfield near the base of the northern- and western-sloping hillsides, where the low-lying area exists within which the wellfield lies, including Paradise Spring, which has been used as a drinking water source.

2.2 Site Topography, Geology, and Hydrogeology

Topography across the site generally slopes northward, with ground surface elevations along the northern edge of the former NASB typically in the 60 to 70 ft msl range while the wellfield generally is at an elevation around 10 ft msl. A relatively steep, approximately 30-feet-high escarpment runs east-west between the former NASB/Bath Road and the JA wellfield. A number of springs are located along the base of this escarpment. East of the northern runway/JA wellfield area, a small stream valley with associated ponds flows north-northeast from the Building 653 area. A local topographic high runs south-southwest to north-northeast between the JA wellfield area and the stream valley draining the Building 653 area. This topographic high corresponds to a local bedrock high identified in the 1994 hydrogeology report for the JA wellfield (CEH, 1994), and was locally confirmed during the 2022 JA wellfield investigation via a test boring (SB-01) drilled immediately south of Bath Road within the projected nose of the bedrock high.

Site geology consists of contact between braided stream alluvium associated with the Androscoggin River (to the north) and regressive marine delta deposits (Upper Sand) to the south. Borings drilled as part of the JA wellfield investigation encountered primarily sandy deposits in the northern runway area, with more clay occurring east of the runway. Figure 2-1 is a geologic cross section of the study area. Along the western side of the investigation area, sandy strata were encountered north and south of Bath Road from ground surface to approximately 40 feet below ground surface (bgs). A mix of predominantly finer grained clay/silt materials with some sandy lenses were encountered at approximately 87 to 117 feet bgs (Figure 2-1). Slightly to the east, directly north and east of the eastern runway and taxiway, the subsurface materials consist primarily of sandy strata. The clayey/silty strata found to the west (and also farther to the east) are absent in this area. East of JA-03S/D at MW-500/500D, sands were found to a depth of 30 feet bgs, then a mix of sandy and silty/clayey deposits to 50 feet bgs, then a thick clay/silt sequence (Presumpscot Clay) was encountered to refusal at a depth of 63 feet bgs (Figure 2-1). Farther east and southeast, clayey materials were found throughout the area at shallow depths, with a relatively thin sand layer present in most areas above the clay.

Groundwater is encountered at depths ranging from less than 2 feet bgs to approximately 45 feet bgs in monitored JA wells. The water table is predominantly encountered in shallow sandy strata; however, in a few locations within the Building 653 area, surficial sand thickness is minimal and the water table is encountered immediately above or within silty/clayey strata. A potentiometric surface elevation map is presented on Figure 2-2. Groundwater flow across the northern runway area is generally northward towards the JA wellfield. The flow gradient is very low across the runway area itself, then steepens as groundwater approaches Bath Road and the escarpment area. In the northeastern portion of the investigation area, from Hangar 6 to the property boundary, groundwater flow is locally controlled by the small stream draining the Building 653 area, as groundwater flows northeast, north, and northwest to this surface water system (stream and associated ponds). A groundwater divide was identified/delineated onsite, with Hangar 6 and Building 653 located north of the divide, and the Old Navy Fuel Farm south of the divide.

2.3 Previous Investigations

Numerous environmental investigations have been conducted between 2010 and 2022 to investigate and delineate the extent of PFAS across the former base and have established the presence of PFAS, specifically perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA), in groundwater, surface water, sediment, and stormwater at former NAS Brunswick. Major investigations that included the northern portion of the former base include:

- November 2014 Basewide Perfluorinated Compound (PFC) Sampling
- November and December 2014 Eastern Flightline Investigation
- November 2015 Basewide PFC Sampling
- June 2017 Former Building 653 PFAS Investigation
- October 2017 Limited Basewide PFAS Investigation
- May 2018 Basewide PFAS Investigation

The Per- and Polyfluoroalkyl Substances (PFAS) Investigation Summary Report (Resolution, 2020) documents the results of these investigations. In the northern portion of the former NASB, the Building 653 area in particular was identified through these investigations as an area with significant PFAS impacts in groundwater and surface water.

In 2021, the Navy was notified by BTWD that PFAS had been detected at the Jordan Avenue Wellfield at levels above the 2021 Maine interim standard for community water systems. Because the JA wellfield is impacted and BTWD has associated water supply concerns, an expedited investigation by the Navy was executed to develop a better understanding of the nature and extent of PFAS impacts. A work plan was developed to obtain data with which to further understand the nature and extent of PFAS impacts within and around the wellfield, to assist in identifying what/where the PFAS source(s) are, and to rapidly develop a long-term strategy to address the wellfield impacts. The work plan (Tetra Tech, 2022a) addressed the expedited installation of new monitoring wells and sampling of monitoring wells, surface water, springs, and storm drains in order to obtain additional PFAS data in the JA wellfield area; it was also the basis for the field investigation work completed in April and May 2022. In addition, the northern former NASB area (including the runway area) was also investigated to evaluate whether any previously unidentified PFAS sources/releases in the northern base area could be contributing to the PFAS detected in the JA wellfield.

The following activities were performed to further delineate and evaluate the presence of PFAS at the JA wellfield:

- A one-day site reconnaissance was performed on April 13, 2022, to examine the general area, to develop a better understanding of the wellfield setting, and to identify sampling points, particularly local springs. Planned new monitoring well locations were marked for utility clearance. Representatives of the Navy, USEPA, MEDEP, BTWD, and Brunswick Area Citizens for a Safe Environment (BACSE) participated in the reconnaissance.
- New monitoring wells were installed upgradient of the JA wellfield, along with the new PFAS remedial investigation (RI) wells proposed at the Building 653/Northern Area/Hangar 6 area (Figure 1-2). During well drilling activities, soil sampling or cone penetrometer technology drilling was performed to obtain lithology information for each location.
- Surface water samples were collected from:
  - The local stream that that flows east through the JA wellfield at four locations: (1) far upstream of the wellfield near Elaine Drive, (2) near the upstream (JA) edge of the wellfield, (3) near the downstream exit point from the wellfield area, and (4) at a location approximately midway between the upstream and downstream wellfield area points.
  - The Androscoggin River, along the shoreline upstream, mid-point, and downstream of the wellfield.
  - A small pond located near Bath Road near the southeastern corner of the BTWD property.
- Samples were collected from 13 local springs discharging within the general wellfield area between the former NASB and the JA wellfield.
- Select existing and new monitoring wells were sampled within and upgradient of the wellfield, including all of the 200-series wells located within the wellfield and upgradient NASB monitoring wells located within the northern on-base area and north of Bath Road (Figure 1-2).

Table 2-1 summarizes the sampling program for the Navy's 2022 JA wellfield investigation. All samples were analyzed for 29 PFAS compounds using the analytical method planned for the PFAS RI (Liquid Chromatography (LC)/ mass spectrometry (MS)/MS compliant with Table B-15 of DoD Quality Systems Manual (QSM) 5.3/Standard Operating Procedure (SOP)-49).

In addition to the sampling activities, staff gauges were installed at two ponds located in the Building 653 area, within a seasonally ponded area near the two ponds, and along the stream that flows north-northeast from the ponds at a location north of Bath Road (see Figure 1-2). The staff gauges and new monitoring wells were surveyed for location and vertical elevation, and the surface water/spring/storm drain sampling locations were surveyed for location. A comprehensive synoptic round of water levels was collected on May 12, 2022, from the monitoring wells included in Figure 1-2, and from selected wells south of the investigation area to delineate the groundwater divide in that area. For more specific details on the site investigation, refer to the JA wellfield area groundwater investigation Technical Memorandum (Tetra Tech, 2022b).

2.4 Source, Nature, and Extent of Impacts

This section summarizes the source, nature, and extent of groundwater impacts at the JA wellfield. More detailed summaries are provided in the Technical Memorandum (Tetra Tech, 2022b). Tables of analytical results are provided in tables 2 through 5 included in the Groundwater Investigation Technical Memorandum (Tetra Tech, 2022b).

Groundwater sampling results are compared to the most recent State of Maine PFAS standard.

2.4.1 Source of Impacts

The Building 653 area and the Hangar 6 area are the closest known former NASB PFAS source areas to the wellfield and required further investigation by the Navy relative to their potential to be the source of PFAS, or a significant contributing source, to the JA wellfield (Figure 1-2). Results of the spring 2022 investigation suggest that the Building 653 area is not the source of PFAS at the wellfield. More definitive findings are expected as a result of the current PFAS RI. The Hangar 6 area was determined not to be the primary source. The northern runway area appears to be the source area for the PFAS detected in groundwater at MW-JA03S and D, although the specific PFAS source area(s) at former NASB and the release mechanism(s) are yet to be identified.

2.4.2 Nature of Impacts

PFAS are a large group of human-made chemicals that have been used in industry, consumer, and commercial products worldwide since the 1950s. The PFAS chemicals themselves are very long lasting and consist of components that break down very slowly over time no matter the environmental media they are found in. Because of their widespread use and their persistence in the environment, many PFAS are found in the blood of humans and animals all over the world.

2.4.3 Extent of Impacts

In the northwestern runway area and western-southwestern JA wellfield area, PFAS concentrations in groundwater are at levels below Maine interim drinking water standards for 6 regulated PFAS, indicating no significant PFAS impacts to groundwater in this area. Seven of the 8 wells sampled in this area (JA-01D, JA-02D, JA-04S, JA-05S, 205R, 206, and MW27) had no detections of the 6 regulated PFAS compounds, and one well (202, located near the northwestern corner of the JA wellfield) had only 5.6 ng/L of the Maine interim standard PFAS compounds (Figure 2-3).

Farther to the east, in the north-central to northeast runway area and eastern JA wellfield area, higher concentrations of PFAS compounds were detected, with the maximum PFAS concentrations detected at monitoring well cluster MW-JA03S/03D, located near Bath Road and near the northeastern corner of the northern runaway area, where a stormwater drain line and associated shallow ditch is currently present (Figure 2-3). PFAS concentrations in well JA-03S exceeded the Maine interim standard, while both the Maine interim standard and the USEPA 2016 HA were exceeded in well JA-03D. PFHxS was the PFAS compound detected at the highest concentrations in these two wells, as well as the PFAS compound detected most frequently and at the highest concentrations in the other wells in the northern/northeastern runway area. Other wells that had an exceedance of the Maine interim standard in this area include monitoring well 208 and JA-06S. Well JA-07S, located south of and upgradient of the JA-03S/D cluster, had a combined concentration of 6.1 ng/L of the Maine interim standard PFAS compounds.

East and southeast of cluster MW-JA-03S/D, between the northern runway area and the Building 653 area, levels ranging from ND to 12.7 ng/L of the Maine interim standard PFAS were detected at cluster MW-500S/D and well MW-501. This, in combination with the groundwater flow pattern, indicates that the source of the PFAS in JA-03S/D is not the Building 653 area (i.e., PFAS are not migrating northwest from the Building 653 area to the JA wellfield) and that the stream and pond complex north and northeast of Building 653 controls groundwater migration in that area. It is expected, however, that groundwater flow from the Hangar 6 area would primarily be to the north-northeast towards the stream and pond complex. In addition, PFAS concentrations in the Hangar 6 area are much lower than were observed at the JA03S/D cluster. Farther to the southeast, PFAS concentrations in wells MW-504 and MW-528, located immediately downgradient of Hangar 6, exceeded the Maine interim standard, and as did the sample from well NASB-004, sampled in lieu of MW-525, in which both the Maine interim standard and the USEPA 2016 HA for combined PFOA/PFOS were exceeded.

Maine interim drinking water standard PFAS compounds were detected in 8 of the 13 spring samples collected in the JA wellfield investigation, with the highest concentrations detected in spring samples SPR06 and SPR09 (Figure 2-4). Both of these locations are north/northwest of, and generally downgradient of, monitoring well cluster MW-JA03S/D, and are mixed in with other nearby spring samples with much lower PFAS concentrations. Five of the springs (SPR03, SPR05, SPR06, SPR07, and SPR09) had PFAS detections above the Maine interim standard (20 ng/L, combined), with SPR09 also exceeding the USEPA 2016 HA for combined PFOA/PFOS. Paradise Spring (JAW-SPR13) did not have any detections of PFAS compounds above project laboratory detection limits.

Surface water samples were collected from four locations along the unnamed stream that flows parallel to the lower wellfield, from three Androscoggin River locations, and from a small pond located near Bath Road (Figure 2-5). For the unnamed wellfield stream, PFAS compounds were detected in all four samples, including the far upstream sample (SW01). The highest PFAS concentrations were detected in the farthest downstream sample from this stream (SW04), which was collected from a location near where a small unnamed tributary (originating from the area of springs farther south) discharges into the wellfield stream, and where the stream exits the wellfield area to the north. None of the detections exceeded the human health screening criteria for surface water, nor did they exceed the Maine interim standard.

No PFAS were detected at concentrations above project laboratory detection limits in any of the Androscoggin River samples, and no Maine-regulated PFAS were detected at concentrations above the project laboratory detection limits in the sample from the small pond near Bath Road.

2.5 Analytical Data

Analytical results for the groundwater sampling performed during the 2022 investigation are presented in Table 2-2, along with comparisons to applicable screening criteria. Figure 2-4 is a tag map showing the groundwater sampling results for the six PFAS

(PFOA, PFOS, PFNA, PFDA, PFHpA, and PFHxS) included in the State of Maine interim standard of 20 ng/L (combined for these six) for community water systems.

2.6 Streamlined Risk Evaluation

The JA wellfield is a municipal potable water source for BTWD. PFOA and PFOS have been recently detected in groundwater at the former base immediately upgradient of the municipal wellfield at concentrations well above the USEPA 2016 HA of 70 ng/L which could cause concentrations to increase in production wells to above the 2016 HA and thus increase potential risks to a potable drinking water source. The observed concentrations of six Maine regulated PFASs were found to exceed the Maine interim standard. The water treatment plant for the Brunswick and Topsham Water District does not remove PFAS chemicals from the raw water; therefore, a removal action is required to mitigate the risk to human health. No risk evaluation was warranted because concentrations of Maine regulated PFASs exceed the interim standard.

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3.0 Identification of Removal Action Objectives

RAOs are medium-specific goals established to protect human health and the environment and to provide the basis for selecting and implementing a removal action. This section defines the RAOs for the removal action at the JA wellfield, including statutory limits, ARARs, proposed removal action scope, and proposed removal action schedule.

3.1 Statutory Limits on Removal Action

The Navy has determined that an NTCRA is an appropriate response to address potential drinking water exposure to PFOA and PFOS concentrations above the USEPA 2016 HA caused by historical activities at former NAS Brunswick. The NCP (40 CFR 300.415) dictates statutory limits of $2 million and 12 months for USEPA fund-financed removal actions, with statutory exemptions for emergencies and actions consistent with the removal action to be taken. However, the removal action evaluated in this EE/CA will not be USEPA fund-financed, and these statutory limits do not apply for this action.

3.2 Compliance with Applicable or Relevant and Appropriate Requirements

ARARs are used to develop criteria by which RAOs and removal action technologies can be established. The definition of ARARs, as presented in the NCP, is as follows:

Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal environmental or state environmental laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site. Only those state standards identified by a state in a timely manner and more stringent than federal requirements may be considered applicable requirements.

Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal environmental or state environmental laws that, although not applicable to a hazardous substance, a pollutant, a contaminant, a remedial action, or other circumstances at a CERCLA site, address problems or situations sufficiently similar to those encountered at a site so that their use is well suited to the particular site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be considered as relevant and appropriate requirements.

ARARs can include any promulgated standard, requirement, criterion, or limitation under a state environmental or facility-siting law that is more stringent than the associated federal standard, requirement, criterion, or limitation. In addition to ARARs, other regulations and guidance may be classified as "To Be Considered" (TBC). TBCs are non-promulgated, non-enforceable guidelines or criteria that may aid in developing and evaluating removal action alternatives and establishing treatment goals.

ARARs are classified into three broad categories based on how they are applied during a removal action. These categories are chemical-specific, location-specific, and action-specific.

3.2.1 Chemical-Specific ARARs and TBCs

Chemical-specific ARARs are health or risk management-based numbers or methodologies that result in the establishment of numerical values for a given media that would meet the NCP “threshold criterion” of the overall protection of human health and the environment. These requirements generally set protective cleanup concentrations for the chemicals of concern in the designated media or set safe concentrations of discharge for remedial activity. Chemical-specific ARARs may be concentration-based treatment goals or may provide the basis for calculating such levels. In cases where no chemical-specific ARAR exists, chemical advisories may be used to develop removal objectives. The only chemical-specific ARAR is the Maine interim standard that was promulgated under Senate Paper (S.P.) 64 - Legislative Document (L.D.)129.

3.2.2 Location-Specific ARARs

Location-specific ARARs are considered in view of natural or manmade site features. These ARARs are intended to limit activities within designated areas. Maine’s Coastal Program (38 MRSA 1801 et seq), which uses existing rules and identifies specific core laws, is a location-specific ARAR.

3.2.3 Action-Specific ARARs

Action-specific ARARs pertain to implementing a given remedy. These ARARs control or restrict hazardous substance-related or pollutant-related activities. These controls are considered when specific removal activities are planned for a site.

The federal action-specific ARARs and TBCs are as follows:

- Clean Water Act (CWA) National Recommended Water Quality Criteria (NRWQC), CWA Section 304(a)(1). (For potential discharges of backwash water). Status: Applicable.
- Drinking Water HA for Perfluorooctanoic Acid (PFOA) and Drinking Water HA for Perfluorooctane Sulfonate (PFOS), EPA 822-R-16-005 and EPA 822-R-16-004. (Alternative PFAS criteria). Status: TBC

The State action-specific ARARs and TBCs are as follows:

- State of Maine Rules Relating to Drinking Water, 10-144 Code of Maine Regulations Chapter 231. (Requirements for additions to drinking water systems). Status: Applicable
- State of Maine Rules Relating to Erosion and Sedimentation Control, 38 MRSA Part 420-C. Status: Applicable.
- State of Maine Rules Relating to Stormwater Management, 38 MRSA Part 420-D; 06-096 CMR Chapter 500. Status: Applicable.
- State of Maine Rules Relating to Visible Emissions (Fugitive dust), 38 MRSA Part 584; 06-096 CMR Chapter 101. Status: Applicable.
- State of Maine Standards for Generators of Hazardous Waste - Hazardous Waste Determination, 38 MRSA 1301 et seq., 06-096 CMR Chapter 851 (5). Status: Applicable.
- State of Maine Emergency Mandate S.P. 64 – L.D. 129, Resolve, To Protect Consumers of Public Drinking Water by Establishing Maximum Contaminant Levels (MCLs) for Certain Substances and Contaminants. (Interim standard and sampling requirements). Status: Applicable.
- State of Maine Rules relating to Waste Discharges: 06-096 Code of Maine Rules Chapter 521: Applications for Waste Discharge Licenses; Chapter 522. Application Processing Procedures for Waste Discharge Licenses; Chapter 523: Waste Discharge License Conditions; Chapter 524: Criteria and Standards for Waste Discharge Licenses; and Chapter 525: Effluent Guidelines and Standards. (For potential discharges of backwash water). Status: Applicable.

3.3 Removal Action Objectives

RAOs are site-specific goals formed while considering the site-related emerging chemicals of environmental concern, impacted media, chemical mobility, exposure routes and receptors, and treatment goals. The RAOs for the NTCRA for PFAS-impacted drinking water from the JA wellfield is:

- Eliminate existing and future exposure to PFOS and PFOA in drinking water in excess of the 2016 USEPA lifetime HA from the Jordan Avenue Wells.
- Maintain the operation of the current BTWD PFAS mitigation system until the selected removal action has been put into operation.

3.4 Removal Action Scope

The scope of the NTCRA is to remove PFAS from drinking water such that it meets the associated operational standards that BTWD is required to meet. This removal action is an interim action.

3.5 Removal Action Schedule

Since this removal action has been designated non-time-critical, the start date is dependent on the following: completion of public review and subsequent Action Memoranda; the availability of adequate funding and contracting mechanism; and the development and approval of the work plan, design, and specifications. Once the planning and approval process is complete, the removal action can be implemented.

Aside from the previously mentioned dependence upon timely regulatory approval of the Action Memorandum, and adequate funding and contracting availability, there are no other anticipated weather-related restrictions, administrative restrictions, nor material availability restrictions that are expected to impact the removal schedule.

4.0 Identification of Potential Removal Actions and System Configurations

This section identifies the potential removal action options applicable to PFAS remediation at the JA wellfield.

4.1 Potential Removal Action

Technologies for removing emerging chemicals of environmental concern from groundwater can be divided into two broad categories: *in situ* (direct in-place treatment) and *ex situ* (the impacted medium is removed from its original location). Currently, there are no viable technologies for the *in situ* treatment of PFAS that have been proven at the size and scale required for this action nor that can meet the immediate requirement for providing potable water. For this reason, this EE/CA only considers *ex situ* treatment for removal of the PFAS-impacted groundwater that is used for drinking water.

There are two primary established and currently proven technologies for the *ex situ* treatment of PFAS at the size and scale required for drinking water treatment at the JA wellfield: granular activated carbon (GAC) and ion exchange (IX) resin. An emerging alternative adsorbent, CETCO FLUORO-SORB® 200 was also considered as a potential option. These established technologies are described in further detail below.

4.1.1 GAC

GAC is a well-established remedial technology used to remove chemicals from groundwater in a multitude of settings, including drinking water treatment. GAC is an adsorption medium made from a carbon source (such as coconut shells, bituminous coal, or lignite coal). It is activated using either heat or chemicals. PFAS molecules have a hydrophobic tail, which has an affinity for GAC. Typically, GAC is placed in a large vessel, and water is pumped through the vessel. As the water flows past the GAC, PFOS, PFOA, and other PFAS compounds adsorb to the GAC surface and are thereby removed from the water. Over time, the GAC adsorption sites are filled with PFAS molecules, natural occurring organics, and other hydrophobic chemicals (e.g., volatile organic compounds [VOCs]) that may also be present in groundwater. Once the absorption sites on the GAC become filled, the GAC can no longer remove emerging chemicals of environmental concern to levels necessary to reach treatment requirements, and the spent GAC is removed from the vessel and replaced with a fresh batch of GAC. Spent GAC would be taken off-site for regeneration.

GAC is not PFAS-selective. GAC can adsorb many different chemicals from the water. The potential for other chemicals, and naturally occurring substances such as dissolved organic carbon, to compete with PFAS for the GAC adsorption sites must be considered when designing a GAC treatment system. The cost to install, operate, and maintain a GAC system is moderate. Therefore, GAC was retained as a potential technology for removing PFAS from drinking water pumped from the JA wellfield.

4.1.2 Ion Exchange Resin

IX resin is a well-established technology used to remove positively charged (cation) or negatively charged (anion) chemicals from groundwater, including drinking water. PFAS molecules have a negatively charged end that can associate with IX resin through an anionic exchange. Similar to GAC, a vessel is filled with IX resin. As the water flows through the vessel, anions in the water (including PFAS) are exchanged with the anions on the IX resin. Once the exchange sites are filled, the IX resin can no longer remove PFAS to the levels necessary to meet treatment requirements. The spent IX resin is either replaced with fresh single-use IX resin or regenerated on-site if the IX resin is designed and manufactured to be regenerable. Spent single-use resin would be disposed off-site at a landfill.

IX resins used for PFAS treatment can remove other anions present in the groundwater, two of which are nitrate and sulfate. Other anions can compete with PFAS for IX resin exchange sites and must be taken into consideration when designing an IX system. The cost to install, operate, and maintain an IX resin system is moderate. Therefore, IX was retained as a potential technology for removing PFAS from drinking water pumped from the JA wellfield. Regenerable IX resin is not currently being considered but may be revisited as a viable option at a later date.

4.1.3 GAC and Ion Exchange Resin in Series

This method utilizes both GAC and IX in series. The effectiveness of the IX resin starts to decrease when the concentration of total organic carbon is over 2 parts per million (ppm). In this configuration, the raw water is pumped through a bag filter to removed suspended solids and suspended iron. From the bag filter the water goes through a GAC prefilter to lower the organic concentration. The GAC is then followed by the IX resin that target the PFAS. This configuration also reduces the other anions present in the groundwater, such as nitrate and sulfate thereby extending the life of the single use resin. The cost to install, operate, and maintain an IX resin system with GAC is moderate. Therefore, IX with GAC was retained as a potential technology for removing PFAS from drinking water pumped from the JA wellfield.

4.1.4 CETCO FLUORO-SORB®

CETCO FLUORO-SORB is a proprietary alternative (novel) technology that has been used for remediation in limited applications. The technology is being used to treat some groundwater extracted from the JA wellfield followed by discharge of the treated groundwater to the ground surface. The technology was shown to be successful in pilot studies at other locations but is not yet commonly used in drinking water treatment applications. Because the technology is not yet extensively used in drinking water applications, it is not being considered for further evaluation in this EE/CA.

4.2 Potential System Configurations

Two potential system configurations were considered for the JA wellfield. The first configuration would tie into the existing system at the discharge of the existing Raw Water Suction Pumps, using these existing pumps to pressurize the proposed treatment system. The second configuration would include a new vacuum pump system and piping from the upper and lower wellfields to allow for isolation and treatment of each wellfield separately.

4.2.1 Treatment System – Combined Flow

This system configuration proposes a connection to the existing system at the discharge of the Raw Water Suction Pumps in the JA Pump Station. The proposed treatment system influent line would connect just downstream of these pumps, and the discharge of the proposed treatment system would connect to the same main just upstream of the Aeration Units. Both connections would be made on the bottom floor of the existing pump station so the proposed system can be brought on-line or taken off-line from a single location within the existing station. The proposed treatment system would be installed adjacent to the pump station in a prefabricated building. It is assumed that the existing pumps provide adequate pressure for the proposed system and no other upgrades to the existing building would be required. This alternative was retained as a potential system configuration for the JA wellfield treatment system.

4.2.2 Treatment System – Isolation of Wellfields

This system configuration includes more components than the system described above and allows for the isolation and separate treatment of the upper and lower well fields. To do this, modifications to the wellfield distribution system would need to be made. This would likely require new vacuum suction pumps and a new suction line from the upper wellfield to the proposed treatment system, as well as significant additional instrumentation and controls. This alternative may also require other modifications to the existing raw water system. To determine what would be necessary, a more detailed hydraulic analysis of the existing well field and raw water system would need to be completed. At this time, Tetra Tech does not have enough information on the existing system to do this analysis, however, this may be revisited during the design phase if required.

5.0 Identification and Analysis of Removal Action Alternatives

This section identifies the removal action alternatives developed for the JA wellfield and provides an analysis of each alternative based on the criteria specified in USEPA guidance (USEPA, 1993a).

5.1 Evaluation Criteria

As specified in USEPA guidance, three evaluation criteria: effectiveness; implementability; and cost, were used to analyze each of the removal action alternatives in accordance with USEPA guidance (USEPA, 1993). These criteria are described below.

5.1.1 Effectiveness

The effectiveness of an alternative is its ability to meet the RAOs. The following factors are considered:

- Overall protection of public health and the environment.
- Compliance with ARARs and other criteria, advisories, and guidance.
- Long-term effectiveness and permanence: the extent and effectiveness of controls that may be required to manage the risk posed by treatment residuals and/or untreated wastes.
- Reduction of toxicity, mobility, or volume through treatment.
- Short-term effectiveness: the effects of the alternative during the implementation before the RAOs have been met, including protection of workers, community, and environment.

The time to meet the RAO is also included.

5.1.2 Implementability

This criterion evaluates each alternative's technical and administrative feasibility, and the availability of the services and materials needed to implement the alternative. This criterion also considers state acceptance. The following factors are considered:

- Technical feasibility: the ability to implement the remedial technology and the technology's reliability. Technical feasibility is evaluated from construction through operations and maintenance (O&M) of the removal action. This factor also evaluates whether an alternative will contribute to the anticipated performance of any remedial activity.

- Administrative feasibility: the activities needed to coordinate with other regulatory offices and agencies, the need for permits, adherence to applicable non-environmental laws, and concerns from other regulatory agencies.
- Availability of services and materials: whether the requisite personnel, equipment, and materials will be available during the removal action schedule; and whether the technology has been sufficiently developed for full-scale application. If the alternative includes off-base removal and treatment of waste, the off-base treatment capacity is evaluated.

5.1.3 Cost

Removal action costs include capital and O&M costs. For purposes of calculating the present worth for the O&M costs, a 30-year maintenance life, and a 0.5 percent annual discount factor, per Office of Management and Budget Circular A-94, are used (USEPA, 2000).

5.2 Development of Removal Action Alternatives

Based on the evaluation in Section 4.1, the following removal action alternatives were developed for the treatment of drinking water from the JA wellfield:

- Alternative 1: No action.
- Alternative 2: Treatment system with GAC.
- Alternative 3: Treatment system using single-use IX resin.
- Alternative 4: Treatment system using GAC and single-use IX resin.

5.3 Alternative 1 – No Action

There are no removal actions associated with this alternative. This alternative is used as a baseline for comparison to the other removal action alternatives in accordance with the NCP.

5.3.1 Effectiveness

The No Action alternative would not be effective because it does not reduce PFAS concentrations or reduce PFAS toxicity, mobility, or volume, and therefore does not provide long-term protection of human health or the environment. Current risks to human health and the environment would remain. Under current conditions, chemical-specific ARARs and TBCs have not been met; therefore, this alternative would not meet ARARs. This alternative does not achieve the RAOs described in Section 3.0.

5.3.2 Implementability

The No Action alternative is readily implementable because no action would be taken.

5.3.3 Cost

There are no costs associated with the No Action alternative.

5.4 Alternative 2 – Treatment System with Granular Activated Carbon (GAC)

Alternative 2 would use GAC for the removal of PFAS to meet the interim standard. Groundwater will be extracted at a combined flow rate of 800 gpm, and a maximum of 1,000 gpm, from the 138 wells at the JA wellfield. For Alternative 2, the treatment system would consist of a bag filtration system, needed to minimize solids from accumulating on the GAC, followed by two GAC vessels before connecting back to the existing system at the discharge of the raw water suction pumps. The first tie-in, the treatment system influent line, would exit the existing building and tie into a new adjacent building (Figure 5-1), approximately 35 feet by 35 feet in size, on the same parcel before connecting to a bag filtration system. Current sand separator located within the existing system will aid in reducing the amount of aquifer sediments that reach the proposed bag filters. The bag filters would be followed by two in series trains of two GAC vessels, approximately 13 feet in diameter, before discharging to a single line that exits the new building and connects to the existing system downstream of the first tie-in and upstream of the aerators (Figure 5-5). Each train is arranged in a lead-lag configuration, and is capable of treating 800-1,000 gpm, assuming an empty bed contact time (EBCT) of 12 minutes for each GAC tank, see Figure 5-2 for the Alternative 2 building layout. The building design will allow for ease of access to the vessels for efficient media change-out. Each GAC vessel contains approximately 40,000 pounds (lb) of GAC. The influent concentration to the treatment system was estimated using the results for monitoring well 208 from the Groundwater Investigation Technical Memorandum (Tetra Tech, 2022), as well as the data provided by the BTWD. The assumed combined concentration of six PFAS chemicals (PFOA, PFOS, PFNA, PFDA, PFHpA, and PFHxS) is approximately 76 ng/L.

Presence of total organic carbon has been found to reduce GAC's effectiveness at removing PFAS. An increase in TOC from 0.3 mg/L to 1.3 mg/L was found to decrease the lifespan of the GAC from over 80,000 bed volumes to just over 6,000 bed volumes. (Knappe, 2022). The TOC at the JA wellfield is approximately 1.6 mg/L, thus increasing the probability of frequent GAC changeout. This can be evaluated further during the design phase when determining the changeout frequency. For the purposes of this study, a changeout frequency of once per year has been used. Note that breakthrough times are PFAS compound-specific, with longer chain PFAS compounds having a greater affinity for adsorption onto carbon and thus a longer breakthrough time in comparison to short-chain PFAS compounds. As a result, the changeout frequency may be driven by the short-chain regulated PFAS compounds. PFBA, for example (which is a short-chain PFAS compound currently unregulated in the state of Maine, and has no health advisory) has been observed to begin to break through GAC much sooner than the regulated PFAS compounds.

The backwashing procedure for each train will consist of flushing the GAC tank biannually with a 20 horsepower (HP pump at a rate of 10-12 gpm/square foot (SF), or 1,200-1,350 gpm for 10-15 minutes. Two 22,000-gallon frac tanks will be used for the backwash, one for clean water to be used for the backwash procedure, and one for impacted water. The backwash water will then be allowed to settle, then injected back into the system upstream of the GAC tanks. Backwash water is assumed to be available at startup.

5.4.1 Effectiveness

Protection of Human Health and the Environment

Alternative 2 would protect human health by reducing the concentration of PFAS in drinking water discharged from the JA wellfield to less than the State of Maine interim standard of 20 ng/L. A health and safety plan will be created, and proper personal protection equipment (PPE) will be utilized to protect workers during implementation. Erosion and sediment control measures will be adhered to, ensuring the environment is fully protected during construction. As a result, Alternative 2 would meet the NTCRA RAOs.

Compliance with ARARs

Alternative 2 would comply with all current ARARs.

Long-Term Effectiveness and Performance

Alternative 2 would provide long-term protection by removing PFAS from the drinking water. The long-term adequacy and reliability of this alternative will be dependent on the completion of required O&M for the treatment system to meet current and future effluent discharge criteria for PFAS. Performance and compliance monitoring will be necessary to verify that the interim standard is being met.

Reduction of Toxicity, Mobility or Volume through Treatment

Alternative 2 would treat the drinking water through the use of GAC. PFAS concentrations in treated water would meet the interim standard.

Short-Term Effectiveness

There will be no significant potential risk to human health or the environment while implementing this alternative. Exposure of workers to PFAS during construction, start-up, O&M, and groundwater sample collection would be minimized by wearing appropriate PPE and complying with site-specific health and safety procedures. Proper construction and industrial safety practices will be implemented. The design for the system is estimated to be completed in approximately 9 months, and the construction of the facility could be completed in less than a year. Post-construction prove-out could be completed in approximately 3 months. Therefore, this treatment alternative could be implemented within approximately two years from notice to proceed. It is important to note that estimated timeframes are dependent on unknown factors and could require more or less time to complete.

5.4.2 Implementability

Technical Feasibility

The proposed site was evaluated, selected, and sized to adhere to all required standards required for this project. Alternative 2 is technically feasible. However, the EBCT (12 minutes per vessel) required to remove the concentrations of PFAS present at the JA wellfield would require large vessels and volumes of GAC. Construction could be completed using conventional construction equipment and services. Additionally, this alternative would require a large footprint to accommodate the larger GAC vessels.

Availability of Services and Materials

Alternative 2 will be readily implementable and there are several suppliers of GAC and GAC tanks.

The treatment system could readily be constructed and will require qualified personnel for operation and maintenance. The resources, equipment, and materials required for these activities are all standard and are readily available.

Administrative Feasibility

Alternative 2 is administratively feasible. The treatment system for the JA wellfield would be required to obtain all federal, state, and local permits prior to construction. A Maine discharge permit would be needed prior to the discharge of any GAC backwash water.

No easements of right-of-way requirements or impacts to adjoining properties have been identified at this time, and those impacts will need to be reevaluated prior to construction.

Exemption from statutory limits is not needed at this time.

5.4.3 Cost

Capital Costs

The estimated capital cost of Alternative 2 is approximately $3,229,000.

Operations and Maintenance Costs

The annual O&M cost for the GWTS will be approximately $341,000. Over a 30-year period, the present worth cost of the system is approximately $12,128,000. A detailed cost estimate is provided in Appendix A. The O&M costs do not include labor, as it was assumed labor would be done by existing BTWD staff. Additional details regarding any additional Navy funding will be developed at a later date.

5.5 Alternative 3 - Treatment System with Single-Use Ion Exchange (IX) Resin

As in Alternative 2, groundwater will be extracted at a combined flow rate of 800 gpm, and a maximum of 1,000 gpm, from the 138 wells at the JA wellfield. For Alternative 3, the treatment system would consist of a bag filtration system needed to minimize solids from accumulating IX resin, then two IX vessels before connecting back to the existing system at the discharge of the raw water suction pumps. The first tie-in, at the treatment system influent line, would exit the existing building and tie into a new adjacent building (Figure 5-1), approximately 30 feet by 30 feet in size, on the same parcel before connecting to a bag filtration system. Current sand separator located within the existing system will aid in reducing the amount of aquifer sediments that reach the proposed bag filters. The bag filters would be followed by two trains of a IX vessel, four vessels total, approximately 10-foot in diameter, in series before discharging to a single line that exits the new building and connects to the existing system downstream of the first tie-in and upstream of the aerators (Figure 5-6). Each train is arranged in a lead-lag configuration and is capable of treating 800-1,000 gpm, assuming an empty bed contact time (EBCT) of 3 minutes for each IX resin tank; see Figure 5-3 for the Alternative 3 building layout.

The building design will allow for ease of access to the vessels for efficient media change-out. Each of the IX vessels would contain 320 cubic feet of IX resin.

Single-use IX resins have a higher removal capacity and are more effective at treating low concentrations of PFAS. Once the IX resin is spent, it will be replaced with new IX resin. The IX resin change-out is assumed to occur annually. The spent IX resin will be appropriately disposed of. Refer to Figure 5-6 for the Alternative 3 Process Flow Diagram. The PFAS removal efficiency of IX starts to reduce when the TOC is equal to or greater than 2 mg/L. The approximate concentration of TOC at the JA wellfield is 1.6 mg/L for the combined flow from the upper and lower wellfield. It is possible that as more data is collected, or if the treatment of the upper and lower wellfields are done separately, the TOC could increase in the process water, requiring more frequent changeout of the IX resin. For the purposes of this study a changeout frequency of once every other year has been used. As with GAC, breakthrough times are PFAS compound-specific, with longer chain PFAS compounds having a greater affinity for adsorption onto resin and thus a longer breakthrough time in comparison to short-chain PFAS compounds. As a result, the changeout frequency may be driven by the short-chain regulated PFAS compounds. As an example, PFBA (which is a short-chain PFAS compound currently unregulated in the state of Maine, and has no health advisory) has been found to begin to breakthrough IX at around 35,000 bed volumes in comparison to longer-chain PFAS compounds that break through much later, at around 648,000 bed volumes.

The backwashing procedure for each train will consist of flushing each IX tank annually with a pump rated at a maximum of 10-15 HP to achieve a flow rate of 10-12 gpm/SF or 600-675 gpm for 10 to 15 minutes. The backwash water will be allowed to settle, then injected back into the system upstream of the IX tanks. Backwash water is assumed to be available at startup.

5.5.1 Effectiveness

Protection of Human Health and the Environment

Alternative 3 would protect human health by reducing the concentration of PFAS in drinking water discharged from the JA wellfield to less than the State of Maine interim standard (20 ng/L). A health and safety plan will be created, and proper PPE will be utilized to protect workers during implementation. Erosion and sediment control measures will be adhered to, ensuring the environment is fully protected during construction. Alternative 3 would meet the NTCRA RAOs.

Compliance with ARARs

Alternative 3 would comply with all current ARARs.

Long-Term Effectiveness and Performance

Alternative 3 would provide long-term protection by removing PFAS from the drinking water. The long-term adequacy and reliability of this alternative will be dependent on the completion of required O&M of the treatment system to meet the current and potential future effluent discharge limitations for PFAS. Performance and compliance monitoring will be conducted to verify that the interim standard is being met.

Reduction of Toxicity, Mobility or Volume through Treatment

Alternative 3 would treat the drinking water through the use of IX resin. PFAS concentrations in treated water would meet the interim standard.

Short-Term Effectiveness

No significant potential risk to human health or the environment will occur while implementing this alternative. Exposure of workers PFAS during the start-up, O&M, and groundwater sample collection would be minimized by wearing appropriate PPE and complying with site-specific health and safety procedures. Proper construction and industrial safety practices will be implemented.

The design for the treatment system could be completed in approximately 9 months, and the construction of the facility could be completed in less than a year. Post-construction prove-out could be completed in approximately 3 months. Therefore, this treatment alternative could be implemented within approximately two years from notice to proceed. It is important to note that estimated timeframes are dependent on unknown factors and could require more or less time to complete.

5.5.2 Implementability

Technical Feasibility

Alternative 3 is technically feasible. The proposed site was evaluated, selected, and sized to adhere to all required standards required for this project. Construction could be completed using conventional construction equipment and services. Additionally, this alternative would require a large footprint to accommodate the multiple IX vessels.

Availability of Services and Materials

Alternative 3 will be readily implementable; there are several suppliers of IX tanks but are only a few PFAS-specific IX resin suppliers. The treatment could readily be constructed and will require qualified personnel for operation and maintenance. The resources, equipment, and materials required for these activities are all standard and are readily available.

Administrative Feasibility

Alternative 3 is administratively feasible. The treatment system for the JA wellfield would be required to obtain all Federal, State, and local permits prior to construction. A Maine discharge permit would be needed prior to the discharge of IX backwash water.

No easements of right-of-way requirements or impacts to adjoining properties have been identified at this time, and those impacts will need to be reevaluated prior to construction.

Exemption from statutory limits is not needed at this time.

5.5.3 Cost

Capital Costs

The estimated capital cost of Alternative 3 is approximately $2,977,000.

Operations and Maintenance Costs

Annual GWTS O&M costs associated with the GWTS are estimated to be $116,000. Over a 30-year period, the present worth of the system is approximately $5,626,000. A detailed cost estimate is provided in Appendix A. The O&M costs do not include labor, as it was assumed labor would be done by existing BTWD staff. Additional details regarding any additional Navy funding will be developed at a later date.

5.6 Alternative 4 – Treatment System with Granular Activated Carbon (GAC) and Single-Use Ion Exchange (IX) Resin

As in Alternative 3, groundwater will be extracted at a combined flow rate of 800 gpm, and a maximum of 1,000 gpm, from the 138 wells at the JA wellfield. For Alternative 4, the treatment system would consist of a bag filtration system needed to minimize solids from accumulating on the GAC, followed by a GAC vessel, then two IX vessels before connecting back to the existing system at the discharge of the raw water suction pumps. The first tie-in, at the treatment system influent line, would exit the existing building and tie into a new adjacent building (Figure 5-1), approximately 40 feet by 50 feet in size, on the same parcel before connecting to a bag filtration system. Current sand separators located within the existing system will aid in reducing the amount of aquifer sediments that reach the proposed bag filters. The bag filters would be followed by two trains of a GAC vessel, approximately 13 feet in diameter, followed by two 10-foot-diameter IX vessels in series before discharging to a single line that exits the new building and connects to the existing system downstream of the first tie-in and upstream of the aerators (Figure 5-7). Each train is arranged in a lead-lag configuration and is capable of treating 800-1,000 gpm, assuming an empty bed contact time (EBCT) of 6 minutes for the GAC pre-filter, and 3 minutes for the IX resin; see Figure 5-4 for the Alternative 4 building layout. The building design will allow for ease of access to the vessels for efficient media change-out. Each of the IX vessels would contain 320 cubic feet of IX resin. Each GAC vessel will contain approximately 40,000 lb of GAC.

Single-use IX resins have a higher removal capacity and are more effective at treating low concentrations of PFAS. Once the IX resin is spent, it will be replaced with new IX resin. The GAC will remove the TOC in the water, increasing the PFAS removal efficiency of the IX resin. The GAC change-out is assumed to occur annually, and the IX resin change-out is assumed to be every other year. The spent IX resin will be appropriately disposed of. Refer to Figure 5-7 for the Alternative 4 Process Flow Diagram.

The backwashing procedure for each train will consist of flushing the GAC tank biannually with a 20 HP pump at a rate of 10-12 gpm/SF or 1,200-1,350 gpm for 10-15 minutes. Each IX tank will require an annual backwash with a pump rated at a maximum of 10-15 HP to achieve a flow rate of 10-12 gpm/SF or 600-675 gpm for 10-15 minutes. Two 22,000-gallon frac tanks will be used for the backwash, one for clean water to be used for the backwash procedure, and one for impacted water. The backwash water will be allowed to settle, then injected back into the system upstream of the GAC tanks. Backwash water is assumed to be available at startup.

5.6.1 Effectiveness

Protection of Human Health and the Environment

Alternative 4 would protect human health by reducing the concentration of PFAS in drinking water discharged from the JA wellfield to less than the State of Maine interim standard (20 ng/L). A health and safety plan will be created, and proper PPE will be utilized to protect workers during implementation. Erosion and sediment control measures will be adhered to, ensuring the environment is fully protected during construction. Alternative 4 would meet the NTCRA RAOs.

Compliance with ARARs

Alternative 4 would comply with all current ARARs.

Long-Term Effectiveness and Performance

Alternative 4 would provide long-term protection by removing PFAS from the drinking water. The long-term adequacy and reliability of this alternative will be dependent on the completion of required O&M of the treatment system to meet the current and potential future effluent discharge limitations for PFAS. Performance and compliance monitoring will be conducted to verify that the interim standard is being met.

Reduction of Toxicity, Mobility or Volume through Treatment

Alternative 4 would treat the drinking water through the use of GAC and IX resin. PFAS concentrations in treated water would meet the interim standard.

Short-Term Effectiveness

No significant potential risk to human health or the environment will occur while implementing this alternative. Exposure of workers PFAS during the start-up, O&M, and groundwater sample collection would be minimized by wearing appropriate PPE and complying with site-specific health and safety procedures. Proper construction and industrial safety practices will be implemented.

The design for the treatment system could be completed in approximately 9 months, and the construction of the facility could be completed in less than a year. Post-construction prove-out could be completed in approximately 3 months. Therefore, this treatment alternative could be implemented within approximately two years from notice to proceed. It is important to note that estimated time frames are dependent on unknown factors and could require more or less time to complete.

5.6.2 Implementability

Technical Feasibility

Alternative 4 is technically feasible. The proposed site was evaluated, selected, and sized to adhere to all required standards required for this project. Construction could be completed using conventional construction equipment and services. Additionally, this alternative would require a large footprint to accommodate the multiple IX vessels.

Availability of Services and Materials

Alternative 4 will be readily implementable; there are several suppliers of IX tanks but are only a few PFAS-specific IX resin suppliers. The treatment could readily be constructed and will require qualified personnel for operation and maintenance. The resources, equipment, and materials required for these activities are all standard and are readily available.

Administrative Feasibility

Alternative 4 is administratively feasible. The treatment system for the JA wellfield would be required to obtain all Federal, State, and local permits prior to construction. A Maine discharge permit would be needed prior to the discharge of IX backwash water.

No easements of right-of-way requirements or impacts to adjoining properties have been identified at this time, and those impacts will need to be reevaluated prior to construction.

Exemption from statutory limits is not needed at this time.

5.6.3 Cost

Capital Costs

The estimated capital cost of Alternative 4 is approximately $4,168,000.

Operations and Maintenance Costs

Annual GWTS O&M costs associated with the GWTS are estimated to be $239,000. Over a 30-year period, the present worth of the system is approximately $10,468,000. A detailed cost estimate is provided in Appendix A. The O&M costs do not include labor, as it was assumed labor would be done by existing BTWD staff. Additional details regarding any additional Navy funding will be developed at a later date.

6.0 Comparative Analysis of Removal Action Alternatives

This section provides a comparative analysis of the three removal action alternatives discussed in Section 5.0. Each of these criteria is discussed in more detail in the subsections that follow.

6.1 Effectiveness

Levels of effectiveness for the treatment alternatives were assessed based on effectiveness criteria described in Section 5.

6.1.1 Protection of Human Health and the Environment

Alternatives 2, 3, and 4 would achieve the identified RAOs. Alternatives 2, 3, and 4 would both provide a high level of protection for human health and the environment by decreasing the concentration of PFAS in the drinking water from the JA wellfield. Alternative 1 would not achieve the RAOs, nor would it provide protection of human health and the environment because no action will be taken.

6.1.2 Compliance with ARARs

Alternatives 2, 3, and 4 would comply with all ARARs and could be implemented in a manner that complies with location- and action-specific ARARs. Alternative 1 would not comply with chemical-specific ARARs, and no location- or action-specific ARARs would apply if no action were taken.

6.1.3 Long-Term Effectiveness and Performance

Alternatives 2, 3, and 4 would all provide long-term protection and constitute permanent solutions for treating PFAS-impacted drinking water from the JA wellfield.

Alternative 1 (No Action) would not be effective long-term and would not meet the RAOs.

6.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternatives 2, 3, and 4 would reduce PFAS concentrations in the drinking water through the use of GAC and/or IX.

Alternative 1 would not reduce toxicity, mobility, or volume of PFAS-impacted water since no action will be taken.

6.1.5 Short-Term Effectiveness

Since no action will be taken as a part of Alternative 1, there will be no additional risk to the community, workers, or the environment resulting from implementing this alternative.

Alternatives 2, 3, and 4 would minimally increase potential risks to site workers because of potential exposure to groundwater and general construction hazards. During O&M of treatment system, Alternatives 2, 3, and 4 would pose additional potential risks to site workers primarily during change out of GAC or resin. However, potential short-term risks to site workers could be mitigated by using PPE, implementing conventional dust suppression techniques, and conducting health and safety monitoring. Potential short-term risks to members of the public could be mitigated through compliance with regulatory requirements.

Alternatives 2, 3, and 4 would be completed within the same timeframe, with 9 months for design, less than one year for construction, and 3 months for startup and prove-out.

6.2 Implementability

Levels of implementability for the treatment alternatives were assessed based on the implementability criteria described in Section 5.

6.2.1 Technical Feasibility

Alternative 1 is easily implementable because no action will be taken. There will be no technical difficulties or uncertainties associated with implementation. The technical feasibility criteria including constructability, operability, and reliability are not applicable.

Alternative 2 is technically feasible; however, the EBCT required to remove PFAS would require a large volume of GAC. This alternative would also require a larger treatment system footprint to accommodate all of the GAC vessels compared to Alternative 3. Construction could be completed using conventional equipment and services.

Alternative 3 is technically feasible. The footprint for the treatment system would be smaller than Alternative 2. Construction could be completed using conventional equipment and services.

Alternative 4 is technically feasible. The footprint for the treatment system would be larger than Alternative 2. Construction could be completed using conventional equipment and services.

6.2.2 Administrative Feasibility

Alternative 1 is administratively feasible as no action is being taken in this alternative.

Alternatives 2, 3, and 4 are administratively feasible. Federal, state, and local permits would be required to implement the proposed treatment system.

6.2.3 Availability of Services and Materials

Alternative 1 requires no services or materials so the availability of resources was not considered.

Alternatives 2, 3, and 4 will be readily implementable. The GWTS and proposed buildings could readily be constructed and will require qualified personnel to operate and maintain this GWTS. The resources, equipment, and materials required for these activities are readily available.

6.3 Cost

The estimated capital cost, annual O&M costs, and present worth associated with construction of the GWTS proposed in each alternative are provided in Tables A-1 through A-8. In order to compare the varying costs of the different alternatives, a present worth analysis was performed. For this EE/CA, the operating period for the present worth analysis was assumed to be 30 years. The analysis calculated the present worth of annual O&M costs over the project life and added the capital costs. Per USEPA guidance, the discount rate of 0.5 percent was used.

There are no costs associated with Alternative 1 because no removal actions or measures would occur.

The estimated capital cost for Alternatives 2, 3, and 4 are approximately $3,229,000 and $2,977,000, and $4,168,000 respectively. The annual O&M costs for Alternatives 2, 3, and 4 are approximately $341,000, $116,000, and $239,000, respectively. Based on an estimated 30-year period and a 0.5 percent discount rate, the present worth of Alternatives 2, 3, and 4 are approximately $12,128,000, $5,626,000, and $10,468,000 respectively. Alternative 3 is estimated to be the least expensive alternative over a 30-year period.

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7.0 Recommended Removal Action Alternative

Based on the comparative analysis of the three removal action alternatives (Section 6.0), the Navy believes that Alternative 4, Treatment System with GAC and IX Resin, would be the best option for achieving the RAOs at the JA wellfield at NASB, and for protecting human health and the environment. This alternative best satisfies the evaluation criteria and would provide a permanent solution. This alternative addresses uncertainties regarding overall system performance better than the other alternatives, and also adds flexibility to the treatment process.

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8.0 References

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TABLE 2-1
SAMPLING LOCATIONS
JORDAN AVENUE WELLFIELD INVESTIGATION

GROUNDWATER	
Well	**General Location**
201	Brunswick Topsham Water District Wells (205R is a replacement well drilled by the Navy at the 205 location)
202	
204	
205R	
206	
207	
208	
NASB-BG-MW-27	Navy wells on BTWD property
NASB-BG-MW-40	
MW-JA01D	New Navy wells installed in the northern runway area for the Jordan Avenue wellfield investigation
MW-JA02D	
MW-JA03S	
MW-JA03D	
MW-JA04S	
MW-JA05S	
MW-JA06S	
MW-JA07S	
MW-500	New Navy wells installed for the PFAS RI and for the Jordan Avenue wellfield investigation
MW-500D	
MW-501	
MW-504	
MW-528	
NASB-004	Existing well substituted for MW-525 (dry well boring)
SPRINGS	
JAW-SPR01 through -SPR12	Various locations along/near base of escarpment between the former NASB and the municipal wellfield
JAW-SPR13	Paradise Spring
SURFACE WATER	
JAW-SW01	Unnamed wellfield area stream, far upstream/background
JAW-SW02 through -SW04	Unnamed wellfield area stream (wellfield area), listed upstream to downstream
JAW-SW05 through -SW07	Androscoggin River; listed upstream to downstream
JAW-SW08	Small pond near/north of Bath Road

TABLE 2-2
GROUNDWATER SAMPLING RESULTS
JORDAN AVENUE WELLFIELD INVESTIGATION

SAMPLE ID MATRIX SAMPLE DATE	Units	EPA	Maine Residential	**JAW-BG-GW27** **GW** **04/22/2022**	**JAW-BG-GW40** **GW** **04/22/2022**	**JAW-GW201** **GW** **04/22/2022**
PFAS	**UNITS**					
PERFLUOROOCTANESULFONIC ACID (PFOS)	NG/L	70	400	4.31 U	4.42 U	4.31 U
PENTADECAFLUOROOCTANOIC ACID (PFOA)	NG/L	70	400	4.31 U	3.45 J	4.31 U
PERFLUOROHEPTANOIC ACID (PFHPA)	NG/L	NC	NC	4.31 U	4.42 U	7.79 J
PERFLUORONONANOIC ACID (PFNA)	NG/L	NC	NC	4.31 U	4.42 U	4.31 U
PERFLUOROHEXANESULFONIC ACID (PFHXS)	NG/L	NC	NC	4.31 U	6.02 J	3.36 J, Q
PERFLUORODECANOIC ACID (PFDA)	NG/L	NC	NC	4.31 U	4.42 U	4.31 U
PFOS + PFOA + PFHpA + PFNA + PFHxS + PFDA	NG/L	NC	20	0	9.47	11.15
PFOS + PFOA	NG/L	70	NC	0	3.45	0
11CL-PF3OUDS	NG/L	NC	NC	4.31 U	4.42 U	4.31 U
4,8-DIOXA-3H-PERFLUORONONANOIC ACID (ADONA)	NG/L	NC	NC	4.31 U	4.42 U	4.31 U
4:2 FLUOROTELOMER SULFONATE	NG/L	NC	NC	4.31 U	4.42 U	4.31 U
6:2 FLUOROTELOMER SULFONATE (6:2FTS)	NG/L	NC	NC	4.31 U	4.42 U	4.31 U
8:2 FLUOROTELOMER SULFONATE (8:2FTS)	NG/L	NC	NC	4.31 U	4.42 U	4.31 U
9CL-PF3ONS	NG/L	NC	NC	4.31 U	4.42 U	4.31 U
HEXAFLUOROPROPYLENE OXIDE DIMER ACID (HFPO-DA)	NG/L	NC	NC	4.31 U	4.42 U	4.31 U
N-ETHYLPERFLUOROOCTANE SULFONAMIDOACETATE(NEFOSA)	NG/L	NC	NC	4.31 U	4.42 U	4.31 U
N-METHYLPERFLUOROOCTANE SULFONAMIDOACETATE(NMFOSA)	NG/L	NC	NC	4.31 U	4.42 U	4.31 U
NONAFLUORO-3,6-DIOXAHEPTANOIC ACID (NFDHA)	NG/L	NC	NC	4.31 U	4.42 U	4.31 U
PERFLUORO(2-ETHOXYETHANE)SULFONIC ACID (PFEESA)	NG/L	NC	NC	4.31 U	4.42 U	4.31 U
PERFLUORO-3-METHOXYPROPANOIC ACID (PFMPA)	NG/L	NC	NC	4.31 U	4.42 U	4.31 U
PERFLUORO-4-METHOXYBUTANOIC ACID (PFMBA)	NG/L	NC	NC	4.31 U	4.42 U	4.31 U
PERFLUOROBUTANESULFONIC ACID (PFBS)	NG/L	40000	40000	4.31 U	4.42 U	4.31 U
PERFLUOROBUTANOIC ACID (PFBA)	NG/L	NC	NC	4.31 U	4.42 U	18.3
PERFLUORODODECANOIC ACID (PFDOA)	NG/L	NC	NC	4.31 U	4.42 U	4.31 U
PERFLUOROHEPTANESULFONIC ACID (PFHPS)	NG/L	NC	NC	4.31 U	4.42 U	4.31 U
PERFLUOROHEXANOIC ACID (PFHXA)	NG/L	NC	NC	4.31 U	4.42 U	53.5
PERFLUOROPENTANESULFONIC ACID (PFPES)	NG/L	NC	NC	4.31 U	4.42 U	4.31 U
PERFLUOROPENTANOIC ACID (PFPEA)	NG/L	NC	NC	4.31 U	4.42 U	103
PERFLUOROTETRADECANOIC ACID (PFTEA)	NG/L	NC	NC	4.31 U	4.42 U	4.31 U
PERFLUOROTRIDECANOIC ACID (PFTRIA)	NG/L	NC	NC	4.31 U	4.42 U	4.31 U
PERFLUOROUNDECANOIC ACID (PFUNA)	NG/L	NC	NC	4.31 U	4.42 U	4.31 U

Notes:
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U - Non Detect
Q - Ion Ration Outside of Acceptance Criteria
NC - No Criteria
NG/L - nanogram per liter
Black Shading - Exceedance of EPA or Maine Residential Criteria

TABLE 2-2
GROUNDWATER SAMPLING RESULTS
JORDAN AVENUE WELLFIELD INVESTIGATION

SAMPLE ID MATRIX SAMPLE DATE	**JAW-GW202** **GW** **04/23/2022**	**JAW-GW204** **GW** **04/23/2022**	**JAW-GW-205R** **GW** **05/11/2022**	**JAW-GW206** **GW** **04/25/2022**	**JAW-GW207** **GW** **04/25/2022**
PFAS					
PERFLUOROOCTANESULFONIC ACID (PFOS)	4.39 U	4.31 U	4.24 U	4.39 U	4.42 U
PENTADECAFLUOROOCTANOIC ACID (PFOA)	4.39 U	4.31 U	4.24 U	4.39 U	4.42 U
PERFLUOROHEPTANOIC ACID (PFHPA)	5.64 J	4.31 U	4.24 U	4.39 U	4.42 U
PERFLUORONONANOIC ACID (PFNA)	4.39 U	4.31 U	4.24 U	4.39 U	4.42 U
PERFLUOROHEXANESULFONIC ACID (PFHXS)	4.39 U	13	4.24 U	4.39 U	4.42 U
PERFLUORODECANOIC ACID (PFDA)	4.39 U	4.31 U	4.24 U	4.39 U	4.42 U
PFOS + PFOA + PFHpA + PFNA + PFHxS + PFDA	5.64	13	0	0	0
PFOS + PFOA	0	0	0	0	0
11CL-PF3OUDS	4.39 U	4.31 U	4.24 U	4.39 U	4.42 U
4,8-DIOXA-3H-PERFLUORONONANOIC ACID (ADONA)	4.39 U	4.31 U	4.24 U	4.39 U	4.42 U
4:2 FLUOROTELOMER SULFONATE	4.39 U	4.31 U	4.24 U	4.39 U	4.42 U
6:2 FLUOROTELOMER SULFONATE (6:2FTS)	4.39 U	4.31 U	4.24 U	4.39 U	4.42 U
8:2 FLUOROTELOMER SULFONATE (8:2FTS)	4.39 U	4.31 U	4.24 U	4.39 U	4.42 U
9CL-PF3ONS	4.39 U	4.31 U	4.24 U	4.39 U	4.42 U
HEXAFLUOROPROPYLENE OXIDE DIMER ACID (HFPO-DA)	4.39 U	4.31 U	4.24 U	4.39 U	4.42 U
N-ETHYLPERFLUOROOCTANE SULFONAMIDOACETATE(NEFOSA)	4.39 U	4.31 U	4.24 U	4.39 U	4.42 U
N-METHYLPERFLUOROOCTANE SULFONAMIDOACETATE(NMFOSA)	4.39 U	4.31 U	4.24 U	4.39 U	4.42 U
NONAFLUORO-3,6-DIOXAHEPTANOIC ACID (NFDHA)	4.39 U	4.31 U	4.24 U	4.39 U	4.42 U
PERFLUORO(2-ETHOXYETHANE)SULFONIC ACID (PFEESA)	4.39 U	4.31 U	4.24 U	4.39 U	4.42 U
PERFLUORO-3-METHOXYPROPANOIC ACID (PFMPA)	4.39 U	4.31 U	4.24 U	4.39 U	4.42 U
PERFLUORO-4-METHOXYBUTANOIC ACID (PFMBA)	4.39 U	4.31 U	4.24 U	4.39 U	4.42 U
PERFLUOROBUTANESULFONIC ACID (PFBS)	2.53 J, Q	4.31 U	4.24 U	4.39 U	4.42 U
PERFLUOROBUTANOIC ACID (PFBA)	3.87 J	4.31 U	4.24 U	4.39 U	2.65 J
PERFLUORODODECANOIC ACID (PFDOA)	4.39 U	4.31 U	4.24 U	4.39 U	4.42 U
PERFLUOROHEPTANESULFONIC ACID (PFHPS)	4.39 U	4.31 U	4.24 U	4.39 U	4.42 U
PERFLUOROHEXANOIC ACID (PFHXA)	5.28 J, Q	4.31 U	4.24 U	4.39 U	4.42 U
PERFLUOROPENTANESULFONIC ACID (PFPES)	4.39 U	4.31 U	4.24 U	4.39 U	4.42 U
PERFLUOROPENTANOIC ACID (PFPEA)	4.27 J	4.31 U	4.24 U	4.39 U	4.42 U
PERFLUOROTETRADECANOIC ACID (PFTEA)	4.39 U	4.31 U	4.24 U	4.39 U	4.42 U
PERFLUOROTRIDECANOIC ACID (PFTRIA)	4.39 U	4.31 U	4.24 U	4.39 U	4.42 U
PERFLUOROUNDECANOIC ACID (PFUNA)	4.39 U	4.31 U	4.24 U	4.39 U	4.42 U

Notes:
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U - Non Detect
Q - Ion Ration Outside of Acceptance Criteria
NC - No Criteria
NG/L - nanogram per liter
Black Shading - Exceedance of EPA or Maine Residential Criteria

TABLE 2-2
GROUNDWATER SAMPLING RESULTS
JORDAN AVENUE WELLFIELD INVESTIGATION

SAMPLE ID MATRIX SAMPLE DATE	**JAW-GW208** **GW** **04/22/2022**	**JAW-GW500** **GW** **05/10/2022**	**JAW-GW500D** **GW** **05/10/2022**	**JAW-GW-501** **GW** **05/10/2022**	**JAW-GW504** **GW** **05/11/2022**
PFAS					
PERFLUOROOCTANESULFONIC ACID (PFOS)	8.31 J	4.31 U	3.47 J, Q	3.56 J, Q	29.4
PENTADECAFLUOROOCTANOIC ACID (PFOA)	4.61 J	4.31 U	4.1 U	4.42 U	27.2
PERFLUOROHEPTANOIC ACID (PFHPA)	4.31 U	4.31 U	4.1 U	4.42 U	6.83 J
PERFLUORONONANOIC ACID (PFNA)	4.31 U	4.31 U	4.1 U	4.42 U	4.55 U
PERFLUOROHEXANESULFONIC ACID (PFHXS)	63.4	4.31 U	9.23	4.42 U	27.9
PERFLUORODECANOIC ACID (PFDA)	4.31 U	4.31 U	4.1 U	4.42 U	4.55 U
PFOS + PFOA + PFHpA + PFNA + PFHxS + PFDA	76.32	0	12.7	3.56	91.33
PFOS + PFOA	12.92	0	3.47	3.56	56.6
11CL-PF3OUDS	4.31 U	4.31 U	4.1 U	4.42 U	4.55 U
4,8-DIOXA-3H-PERFLUORONONANOIC ACID (ADONA)	4.31 U	4.31 U	4.1 U	4.42 U	4.55 U
4:2 FLUOROTELOMER SULFONATE	4.31 U	4.31 U	4.1 U	4.42 U	4.55 U
6:2 FLUOROTELOMER SULFONATE (6:2FTS)	4.31 U	4.31 U	4.1 U	4.42 U	4.55 U
8:2 FLUOROTELOMER SULFONATE (8:2FTS)	4.31 U	4.31 U	4.1 U	4.42 U	4.55 U
9CL-PF3ONS	4.31 U	4.31 U	4.1 U	4.42 U	4.55 U
HEXAFLUOROPROPYLENE OXIDE DIMER ACID (HFPO-DA)	4.31 U	4.31 U	4.1 U	4.42 U	4.55 U
N-ETHYLPERFLUOROOCTANE SULFONAMIDOACETATE(NEFOSA)	4.31 U	4.31 U	4.1 U	4.42 U	4.55 U
N-METHYLPERFLUOROOCTANE SULFONAMIDOACETATE(NMFOSA)	4.31 U	4.31 U	4.1 U	4.42 U	4.55 U
NONAFLUORO-3,6-DIOXAHEPTANOIC ACID (NFDHA)	4.31 U	4.31 U	4.1 U	4.42 U	4.55 U
PERFLUORO(2-ETHOXYETHANE)SULFONIC ACID (PFEESA)	4.31 U	4.31 U	4.1 U	4.42 U	4.55 U
PERFLUORO-3-METHOXYPROPANOIC ACID (PFMPA)	4.31 U	4.31 U	4.1 U	4.42 U	4.55 U
PERFLUORO-4-METHOXYBUTANOIC ACID (PFMBA)	4.31 U	4.31 U	4.1 U	4.42 U	4.55 U
PERFLUOROBUTANESULFONIC ACID (PFBS)	8.16 J, Q	4.31 U	4.1 U	4.42 U	3.76 J
PERFLUOROBUTANOIC ACID (PFBA)	2.16 J	4.31 U	4.1 U	4.42 U	6.17 J
PERFLUORODODECANOIC ACID (PFDOA)	4.31 U	4.31 U	4.1 U	4.42 U	4.55 U
PERFLUOROHEPTANESULFONIC ACID (PFHPS)	4.31 U	4.31 U	4.1 U	4.42 U	4.55 U
PERFLUOROHEXANOIC ACID (PFHXA)	6.47 J	4.31 U	4.1 U	4.42 U	16
PERFLUOROPENTANESULFONIC ACID (PFPES)	11.4	4.31 U	4.1 U	4.42 U	3.72 J
PERFLUOROPENTANOIC ACID (PFPEA)	4.31 U	4.31 U	4.1 U	4.42 U	16.8
PERFLUOROTETRADECANOIC ACID (PFTEA)	4.31 U	4.31 U	4.1 U	4.42 U	4.55 U
PERFLUOROTRIDECANOIC ACID (PFTRIA)	4.31 U	4.31 U	4.1 U	4.42 U	4.55 U
PERFLUOROUNDECANOIC ACID (PFUNA)	4.31 U	4.31 U	4.1 U	4.42 U	4.55 U

Notes:
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Black Shading - Exceedance of EPA or Maine Residential Criteria

TABLE 2-2
GROUNDWATER SAMPLING RESULTS
JORDAN AVENUE WELLFIELD INVESTIGATION

SAMPLE ID MATRIX SAMPLE DATE	**JAW-GW528** **GW** **05/11/2022**	**JAW-GW-DUP01** **JA03S DUP** **05/11/2022**	**JAW-GW-DUP02** **205R DUP** **05/11/2022**	**JAW-GW-JA01D** **GW** **05/11/2022**	**JAW-GW-JA02D** **GW** **05/11/2022**
PFAS					
PERFLUOROOCTANESULFONIC ACID (PFOS)	13.8	29.5	4.24 U	4.31 U	4.35 U
PENTADECAFLUOROOCTANOIC ACID (PFOA)	2.58 J	21.6	4.24 U	4.31 U	4.35 U
PERFLUOROHEPTANOIC ACID (PFHPA)	4.42 U	3.14 J	4.24 U	4.31 U	4.35 U
PERFLUORONONANOIC ACID (PFNA)	4.42 U	4.39 U	4.24 U	4.31 U	4.35 U
PERFLUOROHEXANESULFONIC ACID (PFHXS)	45.6	64.5	4.24 U	4.31 U	4.35 U
PERFLUORODECANOIC ACID (PFDA)	4.42 U	4.39 U	4.24 U	4.31 U	4.35 U
PFOS + PFOA + PFHpA + PFNA + PFHxS + PFDA	61.98	118.74	0	0	0
PFOS + PFOA	16.38	51.1	0	0	0
11CL-PF3OUDS	4.42 U	4.39 U	4.24 U	4.31 U	4.35 U
4,8-DIOXA-3H-PERFLUORONONANOIC ACID (ADONA)	4.42 U	4.39 U	4.24 U	4.31 U	4.35 U
4:2 FLUOROTELOMER SULFONATE	4.42 U	4.39 U	4.24 U	4.31 U	4.35 U
6:2 FLUOROTELOMER SULFONATE (6:2FTS)	4.42 U	4.39 U	4.24 U	4.31 U	4.35 U
8:2 FLUOROTELOMER SULFONATE (8:2FTS)	4.42 U	4.39 U	4.24 U	4.31 U	4.35 U
9CL-PF3ONS	4.42 U	4.39 U	4.24 U	4.31 U	4.35 U
HEXAFLUOROPROPYLENE OXIDE DIMER ACID (HFPO-DA)	4.42 U	4.39 U	4.24 U	4.31 U	4.35 U
N-ETHYLPERFLUOROOCTANE SULFONAMIDOACETATE(NEFOSA)	4.42 U	4.39 U	4.24 U	4.31 U	4.35 U
N-METHYLPERFLUOROOCTANE SULFONAMIDOACETATE(NMFOSA)	4.42 U	4.39 U	4.24 U	4.31 U	4.35 U
NONAFLUORO-3,6-DIOXAHEPTANOIC ACID (NFDHA)	4.42 U	4.39 U	4.24 U	4.31 U	4.35 U
PERFLUORO(2-ETHOXYETHANE)SULFONIC ACID (PFEESA)	4.42 U	4.39 U	4.24 U	4.31 U	4.35 U
PERFLUORO-3-METHOXYPROPANOIC ACID (PFMPA)	4.42 U	4.39 U	4.24 U	4.31 U	4.35 U
PERFLUORO-4-METHOXYBUTANOIC ACID (PFMBA)	4.42 U	4.39 U	4.24 U	4.31 U	4.35 U
PERFLUOROBUTANESULFONIC ACID (PFBS)	5.43 J	27.7	4.24 U	4.31 U	4.35 U
PERFLUOROBUTANOIC ACID (PFBA)	4.42 U	4.39 U	4.24 U	4.31 U	4.35 U
PERFLUORODODECANOIC ACID (PFDOA)	4.42 U	4.39 U	4.24 U	4.31 U	4.35 U
PERFLUOROHEPTANESULFONIC ACID (PFHPS)	4.42 U	4.39 U	4.24 U	4.31 U	4.35 U
PERFLUOROHEXANOIC ACID (PFHXA)	2.81 J	15.9	4.24 U	4.31 U	4.35 U
PERFLUOROPENTANESULFONIC ACID (PFPES)	8.03 J	30.7	4.24 U	4.31 U	4.35 U
PERFLUOROPENTANOIC ACID (PFPEA)	4.42 U	4.16 J	4.24 U	4.31 U	4.35 U
PERFLUOROTETRADECANOIC ACID (PFTEA)	4.42 U	4.39 U	4.24 U	4.31 U	4.35 U
PERFLUOROTRIDECANOIC ACID (PFTRIA)	4.42 U	4.39 U	4.24 U	4.31 U	4.35 U
PERFLUOROUNDECANOIC ACID (PFUNA)	4.42 U	4.39 U	4.24 U	4.31 U	4.35 U

Notes:
J - Estimated Value
U - Non Detect
Q - Ion Ration Outside of Acceptance Criteria
NC - No Criteria
NG/L - nanogram per liter
Black Shading - Exceedance of EPA or Maine Residential Criteria

TABLE 2-2
GROUNDWATER SAMPLING RESULTS
JORDAN AVENUE WELLFIELD INVESTIGATION

SAMPLE ID MATRIX SAMPLE DATE	**JAW-GW-JA03D** **GW** **05/10/2022**	**JAW-GW-JA03S** **GW** **05/11/2022**	**JAW-GW-JA04S** **GW** **05/10/2022**	**JAW-GW-JA05S** **GW** **05/10/2022**	**JAW-GWJA06S** **GW** **05/10/2022**
PFAS					
PERFLUOROOCTANESULFONIC ACID (PFOS)	115	30.2	4.42 U	4.39 U	5.77 J, Q
PENTADECAFLUOROOCTANOIC ACID (PFOA)	67.1	19.9	4.42 U	4.39 U	9.54
PERFLUOROHEPTANOIC ACID (PFHPA)	6.17 J	3.04 J	4.42 U	4.39 U	4.35 U
PERFLUORONONANOIC ACID (PFNA)	4.24 U	4.35 U	4.42 U	4.39 U	4.35 U
PERFLUOROHEXANESULFONIC ACID (PFHXS)	161	62.9	4.42 U	4.39 U	14
PERFLUORODECANOIC ACID (PFDA)	4.24 U	4.35 U	4.42 U	4.39 U	4.35 U
PFOS + PFOA + PFHpA + PFNA + PFHxS + PFDA	349.27	116.04	0	0	29.31
PFOS + PFOA	182.1	50.1	0	0	15.31
11CL-PF3OUDS	4.24 U	4.35 U	4.42 U	4.39 U	4.35 U
4,8-DIOXA-3H-PERFLUORONONANOIC ACID (ADONA)	4.24 U	4.35 U	4.42 U	4.39 U	4.35 U
4:2 FLUOROTELOMER SULFONATE	4.24 U	4.35 U	4.42 U	4.39 U	4.35 U
6:2 FLUOROTELOMER SULFONATE (6:2FTS)	4.24 U	4.35 U	4.42 U	4.39 U	4.35 U
8:2 FLUOROTELOMER SULFONATE (8:2FTS)	4.24 U	4.35 U	4.42 U	4.39 U	4.35 U
9CL-PF3ONS	4.24 U	4.35 U	4.42 U	4.39 U	4.35 U
HEXAFLUOROPROPYLENE OXIDE DIMER ACID (HFPO-DA)	4.24 U	4.35 U	4.42 U	4.39 U	4.35 U
N-ETHYLPERFLUOROOCTANE SULFONAMIDOACETATE(NEFOSA)	4.24 U	4.35 U	4.42 U	4.39 U	4.35 U
N-METHYLPERFLUOROOCTANE SULFONAMIDOACETATE(NMFOSA)	4.24 U	4.35 U	4.42 U	4.39 U	4.35 U
NONAFLUORO-3,6-DIOXAHEPTANOIC ACID (NFDHA)	4.24 U	4.35 U	4.42 U	4.39 U	4.35 U
PERFLUORO(2-ETHOXYETHANE)SULFONIC ACID (PFEESA)	4.24 U	4.35 U	4.42 U	4.39 U	4.35 U
PERFLUORO-3-METHOXYPROPANOIC ACID (PFMPA)	4.24 U	4.35 U	4.42 U	4.39 U	4.35 U
PERFLUORO-4-METHOXYBUTANOIC ACID (PFMBA)	4.24 U	4.35 U	4.42 U	4.39 U	4.35 U
PERFLUOROBUTANESULFONIC ACID (PFBS)	8.92	29	4.42 U	4.39 U	4.35 U
PERFLUOROBUTANOIC ACID (PFBA)	3.07 J	4.35 U	4.42 U	2.63 J	4.35 U
PERFLUORODODECANOIC ACID (PFDOA)	4.24 U	4.35 U	4.42 U	4.39 U	4.35 U
PERFLUOROHEPTANESULFONIC ACID (PFHPS)	3.18 J	4.35 U	4.42 U	4.39 U	4.35 U
PERFLUOROHEXANOIC ACID (PFHXA)	19.6	14.5	4.42 U	4.39 U	4.35 U
PERFLUOROPENTANESULFONIC ACID (PFPES)	13.5	29.4	4.42 U	4.39 U	4.35 U
PERFLUOROPENTANOIC ACID (PFPEA)	7.94 J	4.16 J	4.42 U	4.39 U	4.35 U
PERFLUOROTETRADECANOIC ACID (PFTEA)	4.24 U	4.35 U	4.42 U	4.39 U	4.35 U
PERFLUOROTRIDECANOIC ACID (PFTRIA)	4.24 U	4.35 U	4.42 U	4.39 U	4.35 U
PERFLUOROUNDECANOIC ACID (PFUNA)	4.24 U	4.35 U	4.42 U	4.39 U	4.35 U

Notes:
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TABLE 2-2
GROUNDWATER SAMPLING RESULTS
JORDAN AVENUE WELLFIELD INVESTIGATION

SAMPLE ID MATRIX SAMPLE DATE	**JAW-GWJA07S** **GW** **05/10/2022**	**JAW-GW-NASB-004** **GW** **05/11/2022**
PFAS		
PERFLUOROOCTANESULFONIC ACID (PFOS)	4.42 U	76.4
PENTADECAFLUOROOCTANOIC ACID (PFOA)	4.42 U	11
PERFLUOROHEPTANOIC ACID (PFHPA)	4.42 U	5.57 J
PERFLUORONONANOIC ACID (PFNA)	4.42 U	4.31 U
PERFLUOROHEXANESULFONIC ACID (PFHXS)	6.08 J	15.2
PERFLUORODECANOIC ACID (PFDA)	4.42 U	4.31 U
PFOS + PFOA + PFHpA + PFNA + PFHxS + PFDA	6.08	108.17
PFOS + PFOA	0	87.4
11CL-PF3OUDS	4.42 U	4.31 U
4,8-DIOXA-3H-PERFLUORONONANOIC ACID (ADONA)	4.42 U	4.31 U
4:2 FLUOROTELOMER SULFONATE	4.42 U	4.31 U
6:2 FLUOROTELOMER SULFONATE (6:2FTS)	4.42 U	4.31 U
8:2 FLUOROTELOMER SULFONATE (8:2FTS)	4.42 U	4.31 U
9CL-PF3ONS	4.42 U	4.31 U
HEXAFLUOROPROPYLENE OXIDE DIMER ACID (HFPO-DA)	4.42 U	4.31 U
N-ETHYLPERFLUOROOCTANE SULFONAMIDOACETATE(NEFOSA)	4.42 U	4.31 U
N-METHYLPERFLUOROOCTANE SULFONAMIDOACETATE(NMFOSA)	4.42 U	4.31 U
NONAFLUORO-3,6-DIOXAHEPTANOIC ACID (NFDHA)	4.42 U	4.31 U
PERFLUORO(2-ETHOXYETHANE)SULFONIC ACID (PFEESA)	4.42 U	4.31 U
PERFLUORO-3-METHOXYPROPANOIC ACID (PFMPA)	4.42 U	4.31 U
PERFLUORO-4-METHOXYBUTANOIC ACID (PFMBA)	4.42 U	4.31 U
PERFLUOROBUTANESULFONIC ACID (PFBS)	4.42 U	4.31 U
PERFLUOROBUTANOIC ACID (PFBA)	4.42 U	3.46 J
PERFLUORODODECANOIC ACID (PFDOA)	4.42 U	4.31 U
PERFLUOROHEPTANESULFONIC ACID (PFHPS)	4.42 U	4.31 U
PERFLUOROHEXANOIC ACID (PFHXA)	4.42 U	14.3
PERFLUOROPENTANESULFONIC ACID (PFPES)	4.42 U	4.31 U
PERFLUOROPENTANOIC ACID (PFPEA)	4.42 U	8.9
PERFLUOROTETRADECANOIC ACID (PFTEA)	4.42 U	4.31 U
PERFLUOROTRIDECANOIC ACID (PFTRIA)	4.42 U	4.31 U
PERFLUOROUNDECANOIC ACID (PFUNA)	4.42 U	4.31 U

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TABLE 2-3
SPRING SAMPLING RESULTS
JORDAN AVENUE WELLFIELD INVESTIGATION
Page 1 of 4

SAMPLE ID MATRIX SAMPLE DATE	Units	EPA	Maine Residential	**JAW-SPR01** **SPR** **04/20/2022**	**JAW-SPR02** **SPR** **04/20/2022**	**JAW-SPR03** **SPR** **04/20/2022**
PFAS	**UNITS**					
PERFLUOROOCTANESULFONIC ACID (PFOS)	NG/L	70	400	4.42 U	4.5 U	7.9 J, Q
PENTADECAFLUOROOCTANOIC ACID (PFOA)	NG/L	70	400	4.42 U	4.5 U	9.67
PERFLUOROHEPTANOIC ACID (PFHPA)	NG/L	NC	NC	4.42 U	4.5 U	4.71 J
PERFLUORONONANOIC ACID (PFNA)	NG/L	NC	NC	4.42 U	4.5 U	4.46 U
PERFLUOROHEXANESULFONIC ACID (PFHXS)	NG/L	NC	NC	4.42 U	4.5 U	4.68 J
PERFLUORODECANOIC ACID (PFDA)	NG/L	NC	NC	4.42 U	4.5 U	4.46 U
PFOS + PFOA + PFHpA + PFNA + PFHxS + PFDA	NG/L	NC	20	0	0	**26.96**
PFOS + PFOA	NG/L	70	NC	0	0	17.57
11CL-PF3OUDS	NG/L	NC	NC	4.42 U	4.5 U	4.46 U
4,8-DIOXA-3H-PERFLUORONONANOIC ACID (ADONA)	NG/L	NC	NC	4.42 U	4.5 U	4.46 U
4:2 FLUOROTELOMER SULFONATE	NG/L	NC	NC	4.42 U	4.5 U	4.46 U
6:2 FLUOROTELOMER SULFONATE (6:2FTS)	NG/L	NC	NC	4.42 U	4.5 U	10.3
8:2 FLUOROTELOMER SULFONATE (8:2FTS)	NG/L	NC	NC	4.42 U	4.5 U	4.46 U
9CL-PF3ONS	NG/L	NC	NC	4.42 U	4.5 U	4.46 U
HEXAFLUOROPROPYLENE OXIDE DIMER ACID (HFPO-DA)	NG/L	NC	NC	4.42 U	4.5 U	4.46 U
N-ETHYLPERFLUOROOCTANE SULFONAMIDOACETATE(NEFOSA)	NG/L	NC	NC	4.42 U	4.5 U	4.46 U
N-METHYLPERFLUOROOCTANE SULFONAMIDOACETATE(NMFOSA)	NG/L	NC	NC	4.42 U	4.5 U	4.46 U
NONAFLUORO-3,6-DIOXAHEPTANOIC ACID (NFDHA)	NG/L	NC	NC	4.42 U	4.5 U	4.46 U
PERFLUORO(2-ETHOXYETHANE)SULFONIC ACID (PFEESA)	NG/L	NC	NC	4.42 U	4.5 U	4.46 U
PERFLUORO-3-METHOXYPROPANOIC ACID (PFMPA)	NG/L	NC	NC	4.42 U	4.5 U	4.46 U
PERFLUORO-4-METHOXYBUTANOIC ACID (PFMBA)	NG/L	NC	NC	4.42 U	4.5 U	4.46 U
PERFLUOROBUTANESULFONIC ACID (PFBS)	NG/L	40000	40000	4.42 U	4.5 U	2.92 J
PERFLUOROBUTANOIC ACID (PFBA)	NG/L	NC	NC	4.42 U	4.22 J	2.3 J
PERFLUORODODECANOIC ACID (PFDOA)	NG/L	NC	NC	4.42 U	4.5 U	4.46 U
PERFLUOROHEPTANESULFONIC ACID (PFHPS)	NG/L	NC	NC	4.42 U	4.5 U	4.46 U
PERFLUOROHEXANOIC ACID (PFHXA)	NG/L	NC	NC	4.89 J	12.3	3.63 J, Q
PERFLUOROPENTANESULFONIC ACID (PFPES)	NG/L	NC	NC	4.42 U	4.5 U	4.46 U
PERFLUOROPENTANOIC ACID (PFPEA)	NG/L	NC	NC	5.9 J	13.3	3.24 J
PERFLUOROTETRADECANOIC ACID (PFTEA)	NG/L	NC	NC	4.42 U	4.5 U	4.46 U
PERFLUOROTRIDECANOIC ACID (PFTRIA)	NG/L	NC	NC	4.42 U	4.5 U	4.46 U
PERFLUOROUNDECANOIC ACID (PFUNA)	NG/L	NC	NC	4.42 U	4.5 U	4.46 U

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TABLE 2-3
SPRING SAMPLING RESULTS
JORDAN AVENUE WELLFIELD INVESTIGATION

SAMPLE ID MATRIX SAMPLE DATE	**JAW-SPR04** **SPR** **04/20/2022**	**JAW-SPR05** **SPR** **04/20/2022**	**JAW-SPR06** **SPR** **04/20/2022**	**JAW-SPR07** **SPR** **04/20/2022**
PFAS				
PERFLUOROOCTANESULFONIC ACID (PFOS)	4.44 J, Q	3.4 J	55.1	5.19 J
PENTADECAFLUOROOCTANOIC ACID (PFOA)	3.23 J	4.67 U	11.1	2.33 J
PERFLUOROHEPTANOIC ACID (PFHPA)	4.42 U	4.67 U	6 J	4.42 U
PERFLUORONONANOIC ACID (PFNA)	4.42 U	4.67 U	4.95 U	4.42 U
PERFLUOROHEXANESULFONIC ACID (PFHXS)	4.42 U	27.3	212	15.3
PERFLUORODECANOIC ACID (PFDA)	4.42 U	4.67 U	4.95 U	4.42 U
PFOS + PFOA + PFHpA + PFNA + PFHxS + PFDA	7.67	**30.7**	**284.2**	**22.82**
PFOS + PFOA	7.67	3.4	66.2	7.52
11CL-PF3OUDS	4.42 U	4.67 U	4.95 U	4.42 U
4,8-DIOXA-3H-PERFLUORONONANOIC ACID (ADONA)	4.42 U	4.67 U	4.95 U	4.42 U
4:2 FLUOROTELOMER SULFONATE	4.42 U	4.67 U	4.95 U	4.42 U
6:2 FLUOROTELOMER SULFONATE (6:2FTS)	4.42 U	4.67 U	4.95 U	4.42 U
8:2 FLUOROTELOMER SULFONATE (8:2FTS)	4.42 U	4.67 U	4.95 U	4.42 U
9CL-PF3ONS	4.42 U	4.67 U	4.95 U	4.42 U
HEXAFLUOROPROPYLENE OXIDE DIMER ACID (HFPO-DA)	4.42 U	4.67 U	4.95 U	4.42 U
N-ETHYLPERFLUOROOCTANE SULFONAMIDOACETATE(NEFOSA)	4.42 U	4.67 U	4.95 U	4.42 U
N-METHYLPERFLUOROOCTANE SULFONAMIDOACETATE(NMFOSA)	4.42 U	4.67 U	4.95 U	4.42 U
NONAFLUORO-3,6-DIOXAHEPTANOIC ACID (NFDHA)	4.42 U	4.67 U	4.95 U	4.42 U
PERFLUORO(2-ETHOXYETHANE)SULFONIC ACID (PFEESA)	4.42 U	4.67 U	4.95 U	4.42 U
PERFLUORO-3-METHOXYPROPANOIC ACID (PFMPA)	4.42 U	4.67 U	4.95 U	4.42 U
PERFLUORO-4-METHOXYBUTANOIC ACID (PFMBA)	4.42 U	4.67 U	4.95 U	4.42 U
PERFLUOROBUTANESULFONIC ACID (PFBS)	4.42 U	3.99 J	23.4	3.81 J
PERFLUOROBUTANOIC ACID (PFBA)	4.42 U	4.67 U	4.95 U	4.42 U
PERFLUORODODECANOIC ACID (PFDOA)	4.42 U	4.67 U	4.95 U	4.42 U
PERFLUOROHEPTANESULFONIC ACID (PFHPS)	4.42 U	4.67 U	4.72 J	4.42 U
PERFLUOROHEXANOIC ACID (PFHXA)	2.78 J, Q	9.46	19.5	4.42 U
PERFLUOROPENTANESULFONIC ACID (PFPES)	4.42 U	6.35 J	46.2	2.93 J
PERFLUOROPENTANOIC ACID (PFPEA)	4.42 U	11.3	4.01 J	4.42 U
PERFLUOROTETRADECANOIC ACID (PFTEA)	4.42 U	4.67 U	4.95 U	4.42 U
PERFLUOROTRIDECANOIC ACID (PFTRIA)	4.42 U	4.67 U	4.95 U	4.42 U
PERFLUOROUNDECANOIC ACID (PFUNA)	4.42 U	4.67 U	4.95 U	4.42 U

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TABLE 2-3
SPRING SAMPLING RESULTS
JORDAN AVENUE WELLFIELD INVESTIGATION

SAMPLE ID MATRIX SAMPLE DATE	**JAW-SPR08** **SPR** **04/20/2022**	**JAW-SPR09** **SPR** **04/20/2022**	**JAW-SPR10** **SPR** **04/20/2022**	**JAW-SPR11** **SPR** **04/20/2022**
PFAS				
PERFLUOROOCTANESULFONIC ACID (PFOS)	5.22 U	**86.3**	3.74 J, Q	3.42 J, Q
PENTADECAFLUOROOCTANOIC ACID (PFOA)	5.22 U	39.2	4.46 U	5.22 J
PERFLUOROHEPTANOIC ACID (PFHPA)	5.22 U	2.96 J	4.46 U	4.39 U
PERFLUORONONANOIC ACID (PFNA)	5.22 U	4.39 U	4.46 U	4.39 U
PERFLUOROHEXANESULFONIC ACID (PFHXS)	5.22 U	72.9	3.58 J	7.37 J
PERFLUORODECANOIC ACID (PFDA)	5.22 U	4.39 U	4.46 U	4.39 U
PFOS + PFOA + PFHpA + PFNA + PFHxS + PFDA	0	**201.36**	7.32	16.01
PFOS + PFOA	0	**125.5**	3.74	8.64
11CL-PF3OUDS	5.22 U	4.39 U	4.46 U	4.39 U
4,8-DIOXA-3H-PERFLUORONONANOIC ACID (ADONA)	5.22 U	4.39 U	4.46 U	4.39 U
4:2 FLUOROTELOMER SULFONATE	5.22 U	4.39 U	4.46 U	4.39 U
6:2 FLUOROTELOMER SULFONATE (6:2FTS)	5.22 U	4.39 U	4.46 U	4.39 U
8:2 FLUOROTELOMER SULFONATE (8:2FTS)	5.22 U	4.39 U	4.46 U	4.39 U
9CL-PF3ONS	5.22 U	4.39 U	4.46 U	4.39 U
HEXAFLUOROPROPYLENE OXIDE DIMER ACID (HFPO-DA)	5.22 U	4.39 U	4.46 U	4.39 U
N-ETHYLPERFLUOROOCTANE SULFONAMIDOACETATE(NEFOSA)	5.22 U	4.39 U	4.46 U	4.39 U
N-METHYLPERFLUOROOCTANE SULFONAMIDOACETATE(NMFOSA)	5.22 U	4.39 U	4.46 U	4.39 U
NONAFLUORO-3,6-DIOXAHEPTANOIC ACID (NFDHA)	5.22 U	4.39 U	4.46 U	4.39 U
PERFLUORO(2-ETHOXYETHANE)SULFONIC ACID (PFEESA)	5.22 U	4.39 U	4.46 U	4.39 U
PERFLUORO-3-METHOXYPROPANOIC ACID (PFMPA)	5.22 U	4.39 U	4.46 U	4.39 U
PERFLUORO-4-METHOXYBUTANOIC ACID (PFMBA)	5.22 U	4.39 U	4.46 U	4.39 U
PERFLUOROBUTANESULFONIC ACID (PFBS)	5.22 U	3.56 J	4.46 U	4.39 U
PERFLUOROBUTANOIC ACID (PFBA)	5.22 U	4.39 U	4.46 U	4.39 U
PERFLUORODODECANOIC ACID (PFDOA)	5.22 U	4.39 U	4.46 U	4.39 U
PERFLUOROHEPTANESULFONIC ACID (PFHPS)	5.22 U	4.39 U	4.46 U	4.39 U
PERFLUOROHEXANOIC ACID (PFHXA)	5.22 U	9.61	4.46 U	2.5 J, Q
PERFLUOROPENTANESULFONIC ACID (PFPES)	5.22 U	6.54 J	4.46 U	4.39 U
PERFLUOROPENTANOIC ACID (PFPEA)	5.22 U	4.88 J	4.46 U	2.59 J
PERFLUOROTETRADECANOIC ACID (PFTEA)	5.22 U	4.39 U	4.46 U	4.39 U
PERFLUOROTRIDECANOIC ACID (PFTRIA)	5.22 U	4.39 U	4.46 U	4.39 U
PERFLUOROUNDECANOIC ACID (PFUNA)	5.22 U	4.39 U	4.46 U	4.39 U

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TABLE 2-3
SPRING SAMPLING RESULTS
JORDAN AVENUE WELLFIELD INVESTIGATION

SAMPLE ID MATRIX SAMPLE DATE	JAW-SPR12 SPR 04/20/2022	JAW-SPR13 SPR 04/20/2022	JAW-SPR-DUP-042022 SPR09 DUP 04/20/2022
PFAS			
PERFLUOROOCTANESULFONIC ACID (PFOS)	4.46 U	4.31 U	87.5
PENTADECAFLUOROOCTANOIC ACID (PFOA)	4.46 U	4.31 U	40.3
PERFLUOROHEPTANOIC ACID (PFHPA)	4.46 U	4.31 U	2.43 J
PERFLUORONONANOIC ACID (PFNA)	4.46 U	4.31 U	4.46 U
PERFLUOROHEXANESULFONIC ACID (PFHXS)	4.46 U	4.31 U	70.2
PERFLUORODECANOIC ACID (PFDA)	4.46 U	4.31 U	4.46 U
PFOS + PFOA + PFHpA + PFNA + PFHxS + PFDA	0	0	200.43
PFOS + PFOA	0	0	127.8
11CL-PF3OUDS	4.46 U	4.31 U	4.46 U
4,8-DIOXA-3H-PERFLUORONONANOIC ACID (ADONA)	4.46 U	4.31 U	4.46 U
4:2 FLUOROTELOMER SULFONATE	4.46 U	4.31 U	4.46 U
6:2 FLUOROTELOMER SULFONATE (6:2FTS)	4.46 U	4.31 U	4.46 U
8:2 FLUOROTELOMER SULFONATE (8:2FTS)	4.46 U	4.31 U	4.46 U
9CL-PF3ONS	4.46 U	4.31 U	4.46 U
HEXAFLUOROPROPYLENE OXIDE DIMER ACID (HFPO-DA)	4.46 U	4.31 U	4.46 U
N-ETHYLPERFLUOROOCTANE SULFONAMIDOACETATE(NEFOSA)	4.46 U	4.31 U	4.46 U
N-METHYLPERFLUOROOCTANE SULFONAMIDOACETATE(NMFOSA)	4.46 U	4.31 U	4.46 U
NONAFLUORO-3,6-DIOXAHEPTANOIC ACID (NFDHA)	4.46 U	4.31 U	4.46 U
PERFLUORO(2-ETHOXYETHANE)SULFONIC ACID (PFEESA)	4.46 U	4.31 U	4.46 U
PERFLUORO-3-METHOXYPROPANOIC ACID (PFMPA)	4.46 U	4.31 U	4.46 U
PERFLUORO-4-METHOXYBUTANOIC ACID (PFMBA)	4.46 U	4.31 U	4.46 U
PERFLUOROBUTANESULFONIC ACID (PFBS)	4.46 U	4.31 U	3.67 J
PERFLUOROBUTANOIC ACID (PFBA)	4.46 U	4.31 U	4.46 U
PERFLUORODODECANOIC ACID (PFDOA)	4.46 U	4.31 U	4.46 U
PERFLUOROHEPTANESULFONIC ACID (PFHPS)	4.46 U	4.31 U	4.46 U
PERFLUOROHEXANOIC ACID (PFHXA)	4.46 U	4.31 U	9.37
PERFLUOROPENTANESULFONIC ACID (PFPES)	4.46 U	4.31 U	5.48 J
PERFLUOROPENTANOIC ACID (PFPEA)	4.46 U	4.31 U	3.86 J
PERFLUOROTETRADECANOIC ACID (PFTEA)	4.46 U	4.31 U	4.46 U
PERFLUOROTRIDECANOIC ACID (PFTRIA)	4.46 U	4.31 U	4.46 U
PERFLUOROUNDECANOIC ACID (PFUNA)	4.46 U	4.31 U	4.46 U

Notes:
J - Estimated Value
U - Non Detect
Q - Ion Ration Outside of Acceptance Criteria
NC - No Criteria
NG/L - nanogram per liter
Black Shading - Exceedance of EPA or Maine Residential Criteria

TABLE 2-4
SURFACE WATER SAMPLING RESULTS
JORDAN AVENUE WELLFIELD INVESTIGATION

SAMPLE ID MATRIX SAMPLE DATE	Units	PSL*	JAW-SW01 SW 04/21/2022	JAW-SW02 SW 04/21/2022	JAW-SW03 SW 04/21/2022	JAW-SW04 SW 04/21/2022
PFAS	**UNITS**					
PERFLUOROOCTANESULFONIC ACID (PFOS)	NG/L	2030	4.55 U	4.46 U	2.3 J, Q	3.86 J, Q
PENTADECAFLUOROOCTANOIC ACID (PFOA)	NG/L	2030	3.87 J	2.62 J	2.72 J	4.19 J, Q
PERFLUOROHEPTANOIC ACID (PFHPA)	NG/L	NC	3.37 J	4.46 U	4.42 U	4.35 U
PERFLUORONONANOIC ACID (PFNA)	NG/L	NC	4.55 U	4.46 U	4.42 U	4.35 U
PERFLUOROHEXANESULFONIC ACID (PFHXS)	NG/L	NC	4.55 U	4.46 U	3.33 J	8.21 J, Q
PERFLUORODECANOIC ACID (PFDA)	NG/L	NC	4.55 U	4.46 U	4.42 U	4.35 U
PFOS + PFOA + PFHpA + PFNA + PFHxS + PFDA	NG/L	NC	7.24	2.62	8.35	16.26
PFOS + PFOA	NG/L	NC	3.87	2.62	5.02	8.05
11CL-PF3OUDS	NG/L	NC	4.55 U	4.46 U	4.42 U	4.35 U
4,8-DIOXA-3H-PERFLUORONONANOIC ACID (ADONA)	NG/L	NC	4.55 U	4.46 U	4.42 U	4.35 U
4:2 FLUOROTELOMER SULFONATE	NG/L	NC	4.55 U	4.46 U	4.42 U	4.35 U
6:2 FLUOROTELOMER SULFONATE (6:2FTS)	NG/L	NC	4.55 U	4.46 U	4.42 U	4.35 U
8:2 FLUOROTELOMER SULFONATE (8:2FTS)	NG/L	NC	4.55 U	4.46 U	4.42 U	4.35 U
9CL-PF3ONS	NG/L	NC	4.55 U	4.46 U	4.42 U	4.35 U
HEXAFLUOROPROPYLENE OXIDE DIMER ACID (HFPO-DA)	NG/L	NC	4.55 U	4.46 U	4.42 U	4.35 U
N-ETHYLPERFLUOROOCTANE SULFONAMIDOACETATE(NEFOSA)	NG/L	NC	4.55 U	4.46 U	4.42 U	4.35 U
N-METHYLPERFLUOROOCTANE SULFONAMIDOACETATE(NMFOSA)	NG/L	NC	4.55 U	4.46 U	4.42 U	4.35 U
NONAFLUORO-3,6-DIOXAHEPTANOIC ACID (NFDHA)	NG/L	NC	4.55 U	4.46 U	4.42 U	4.35 U
PERFLUORO(2-ETHOXYETHANE)SULFONIC ACID (PFEESA)	NG/L	NC	4.55 U	4.46 U	4.42 U	4.35 U
PERFLUORO-3-METHOXYPROPANOIC ACID (PFMPA)	NG/L	NC	4.55 U	4.46 U	4.42 U	4.35 U
PERFLUORO-4-METHOXYBUTANOIC ACID (PFMBA)	NG/L	NC	4.55 U	4.46 U	4.42 U	4.35 U
PERFLUOROBUTANESULFONIC ACID (PFBS)	NG/L	30400	4.55 U	4.46 U	4.42 U	4.35 U
PERFLUOROBUTANOIC ACID (PFBA)	NG/L	NC	4.55 U	4.46 U	4.42 U	4.35 U
PERFLUORODODECANOIC ACID (PFDOA)	NG/L	NC	4.55 U	4.46 U	4.42 U	4.35 U
PERFLUOROHEPTANESULFONIC ACID (PFHPS)	NG/L	NC	4.55 U	4.46 U	4.42 U	4.35 U
PERFLUOROHEXANOIC ACID (PFHXA)	NG/L	NC	3.29 J	2.26 J, Q	4.42 U	4.19 J, Q
PERFLUOROPENTANESULFONIC ACID (PFPES)	NG/L	NC	4.55 U	4.46 U	4.42 U	4.35 U
PERFLUOROPENTANOIC ACID (PFPEA)	NG/L	NC	4.55 U	4.46 U	4.42 U	4.53 J
PERFLUOROTETRADECANOIC ACID (PFTEA)	NG/L	NC	4.55 U	4.46 U	4.42 U	4.35 U
PERFLUOROTRIDECANOIC ACID (PFTRIA)	NG/L	NC	4.55 U	4.46 U	4.42 U	4.35 U
PERFLUOROUNDECANOIC ACID (PFUNA)	NG/L	NC	4.55 U	4.46 U	4.42 U	4.35 U

Notes:
* EPA Region 1 human health surface water PSLs (from work plan)
PSL - Project screening level
J - Estimated Value
U - Non Detect
Q - Ion Ration Outside of Acceptance Criteria
NC - No Criteria
NG/L - nanogram per liter

TABLE 2-4
SURFACE WATER SAMPLING RESULTS
JORDAN AVENUE WELLFIELD INVESTIGATION

SAMPLE ID MATRIX SAMPLE DATE	**JAW-SW05** **SW** **04/21/2022**	**JAW-SW06** **SW** **04/21/2022**	**JAW-SW07** **SW** **04/21/2022**	**JAW-SW08** **SW** **04/21/2022**	**JAW-SW-DUP-042122** **SW02 DUP** **04/21/2022**
PFAS					
PERFLUOROOCTANESULFONIC ACID (PFOS)	4.39 U	4.55 U	4.42 U	4.42 U	4.35 U
PENTADECAFLUOROOCTANOIC ACID (PFOA)	4.39 U	4.55 U	4.42 U	4.42 U	2.3 J
PERFLUOROHEPTANOIC ACID (PFHPA)	4.39 U	4.55 U	4.42 U	4.42 U	4.35 U
PERFLUORONONANOIC ACID (PFNA)	4.39 U	4.55 U	4.42 U	4.42 U	4.35 U
PERFLUOROHEXANESULFONIC ACID (PFHXS)	4.39 U	4.55 U	4.42 U	4.42 U	4.35 U
PERFLUORODECANOIC ACID (PFDA)	4.39 U	4.55 U	4.42 U	4.42 U	4.35 U
PFOS + PFOA + PFHpA + PFNA + PFHxS + PFDA	0	0	0	0	2.3
PFOS + PFOA	0	0	0	0	2.3
11CL-PF3OUDS	4.39 U	4.55 U	4.42 U	4.42 U	4.35 U
4,8-DIOXA-3H-PERFLUORONONANOIC ACID (ADONA)	4.39 U	4.55 U	4.42 U	4.42 U	4.35 U
4:2 FLUOROTELOMER SULFONATE	4.39 U	4.55 U	4.42 U	4.42 U	4.35 U
6:2 FLUOROTELOMER SULFONATE (6:2FTS)	4.39 U	4.55 U	4.42 U	4.42 U	4.35 U
8:2 FLUOROTELOMER SULFONATE (8:2FTS)	4.39 U	4.55 U	4.42 U	4.42 U	4.35 U
9CL-PF3ONS	4.39 U	4.55 U	4.42 U	4.42 U	4.35 U
HEXAFLUOROPROPYLENE OXIDE DIMER ACID (HFPO-DA)	4.39 U	4.55 U	4.42 U	4.42 U	4.35 U
N-ETHYLPERFLUOROOCTANE SULFONAMIDOACETATE(NEFOSA)	4.39 U	4.55 U	4.42 U	4.42 U	4.35 U
N-METHYLPERFLUOROOCTANE SULFONAMIDOACETATE(NMFOSA)	4.39 U	4.55 U	4.42 U	4.42 U	4.35 U
NONAFLUORO-3,6-DIOXAHEPTANOIC ACID (NFDHA)	4.39 U	4.55 U	4.42 U	4.42 U	4.35 U
PERFLUORO(2-ETHOXYETHANE)SULFONIC ACID (PFEESA)	4.39 U	4.55 U	4.42 U	4.42 U	4.35 U
PERFLUORO-3-METHOXYPROPANOIC ACID (PFMPA)	4.39 U	4.55 U	4.42 U	4.42 U	4.35 U
PERFLUORO-4-METHOXYBUTANOIC ACID (PFMBA)	4.39 U	4.55 U	4.42 U	4.42 U	4.35 U
PERFLUOROBUTANESULFONIC ACID (PFBS)	4.39 U	4.55 U	4.42 U	4.42 U	4.35 U
PERFLUOROBUTANOIC ACID (PFBA)	4.39 U	4.55 U	4.42 U	4.42 U	4.35 U
PERFLUORODODECANOIC ACID (PFDOA)	4.39 U	4.55 U	4.42 U	4.42 U	4.35 U
PERFLUOROHEPTANESULFONIC ACID (PFHPS)	4.39 U	4.55 U	4.42 U	4.42 U	4.35 U
PERFLUOROHEXANOIC ACID (PFHXA)	4.39 U	4.55 U	4.42 U	3.5 J, Q	2.36 J
PERFLUOROPENTANESULFONIC ACID (PFPES)	4.39 U	4.55 U	4.42 U	4.42 U	4.35 U
PERFLUOROPENTANOIC ACID (PFPEA)	4.39 U	4.55 U	4.42 U	3.11 J	4.35 U
PERFLUOROTETRADECANOIC ACID (PFTEA)	4.39 U	4.55 U	4.42 U	4.42 U	4.35 U
PERFLUOROTRIDECANOIC ACID (PFTRIA)	4.39 U	4.55 U	4.42 U	4.42 U	4.35 U
PERFLUOROUNDECANOIC ACID (PFUNA)	4.39 U	4.55 U	4.42 U	4.42 U	4.35 U

Notes:
* EPA Region 1 human health surface water PSLs (from work plan)
PSL - Project screening level
J - Estimated Value
U - Non Detect
Q - Ion Ration Outside of Acceptance Criteria
NC - No Criteria
NG/L - nanogram per liter

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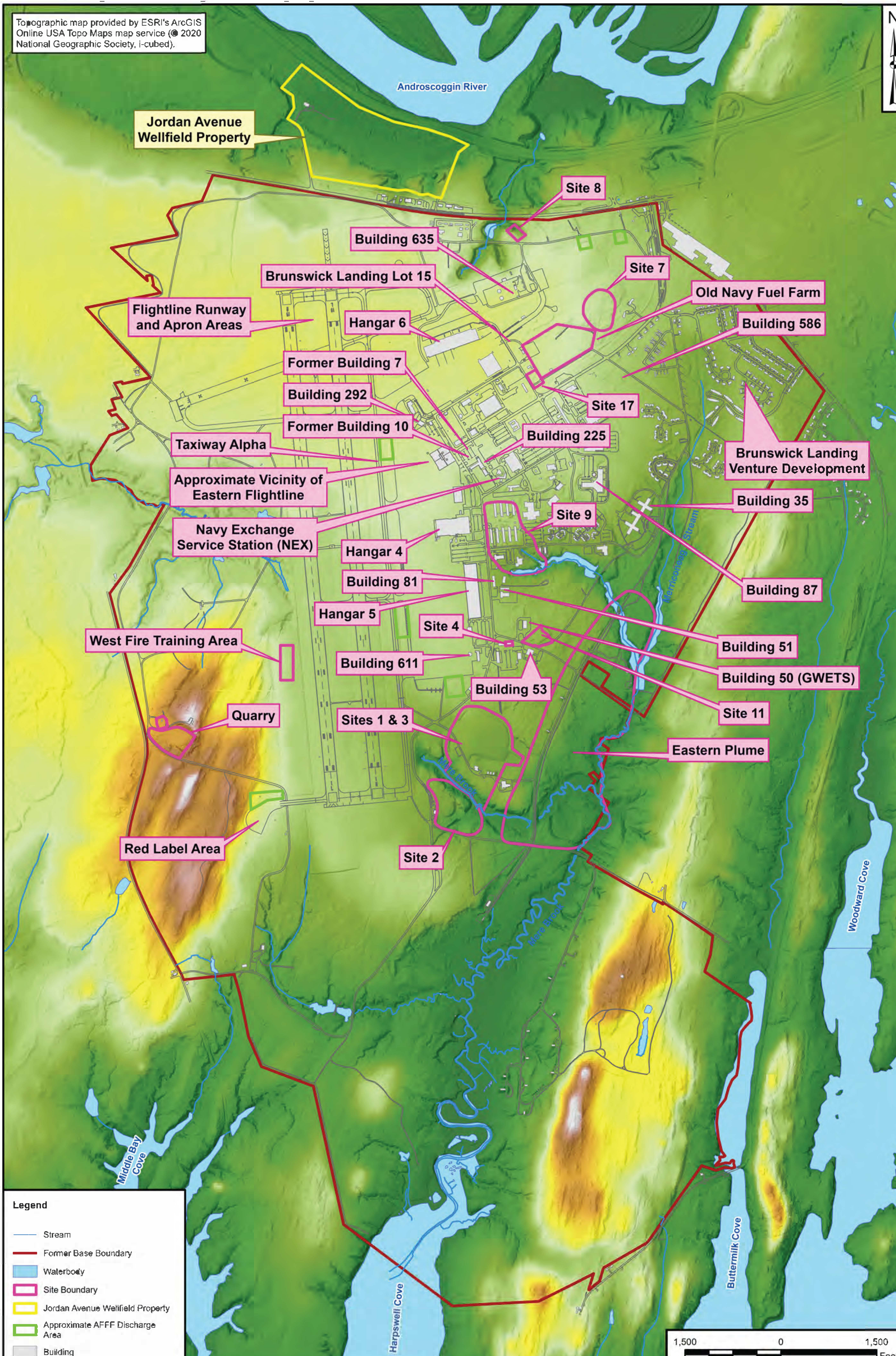

JORDAN AVENUE WELLFIELD AND FORMER BASE LOCATION MAP
FORMER NAVAL AIR STATION
BRUNSWICK, MAINE

NAVFAC
Naval Facilities Engineering Systems Command

DRAWN BY	DATE	CTO
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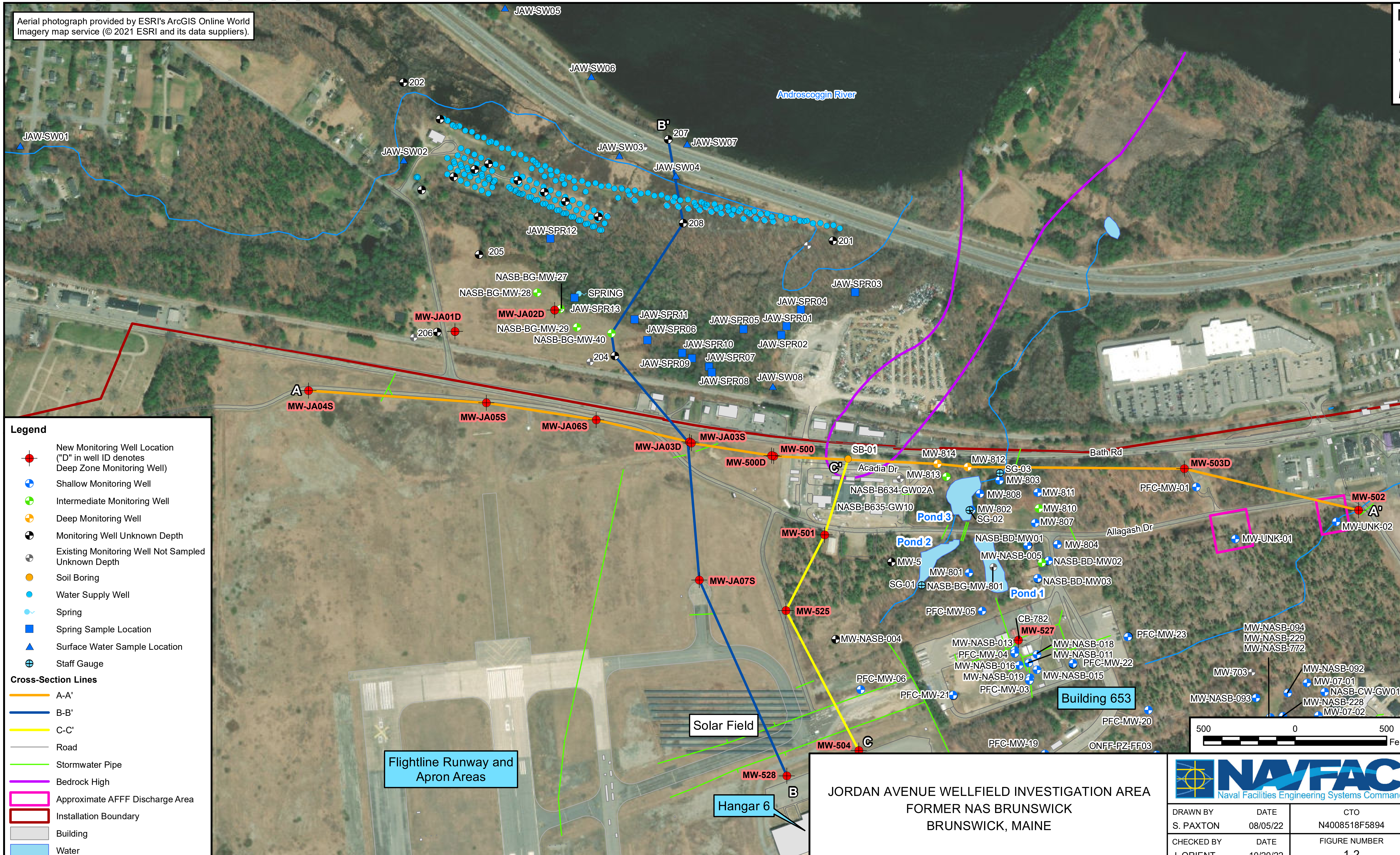
Aerial photograph provided by ESRI's ArcGIS Online World Imagery map service (© 2021 ESRI and its data suppliers).
N
Androscoggin River
JAW-SW01
JAW-SW02
JAW-SW03
JAW-SW04
JAW-SW05
JAW-SW06
JAW-SW07
JAW-SW08
JAW-SPR01
JAW-SPR02
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JAW-SPR07
JAW-SPR08
JAW-SPR09
JAW-SPR10
JAW-SPR11
JAW-SPR12
JAW-SPR13
SPRING
201
202
204
205
206
207
208
B'
NASB-BG-MW-27
NASB-BG-MW-28
NASB-BG-MW-29
NASB-BG-MW-40
MW-JA01D
MW-JA02D
MW-JA03D
MW-JA03S
MW-JA04S
MW-JA05S
MW-JA06S
MW-JA07S
A
A'
MW-500
MW-500D
MW-501
MW-502
MW-503D
MW-504
MW-525
MW-527
MW-528
B
C
C'
SB-01
Bath Rd
Acadia Dr
Allagash Dr
MW-814
MW-812
MW-813
SG-03
MW-803
NASB-B634-GW02A
NASB-B635-GW10
MW-808
MW-811
MW-802
MW-810
SG-02
MW-807
Pond 3
Pond 2
Pond 1
NASB-BD-MW01
MW-804
MW-NASB-005
NASB-BD-MW02
MW-5
MW-801
SG-01
NASB-BG-MW-801
NASB-BD-MW03
PFC-MW-01
MW-UNK-01
MW-UNK-02
PFC-MW-05
CB-782
MW-NASB-004
MW-NASB-013
MW-NASB-018
PFC-MW-04
MW-NASB-011
MW-NASB-016
PFC-MW-22
MW-NASB-019
MW-NASB-015
PFC-MW-03
PFC-MW-06
PFC-MW-21
PFC-MW-23
Building 653
PFC-MW-20
PFC-MW-19
ONFF-PZ-FF03
MW-NASB-094
MW-NASB-229
MW-NASB-772
MW-703
MW-NASB-092
MW-07-01
NASB-CW-GW01S
MW-NASB-093
MW-NASB-228
MW-07-02
Solar Field
Flightline Runway and Apron Areas
Hangar 6
500 0 500
Feet
Legend
New Monitoring Well Location ("D" in well ID denotes Deep Zone Monitoring Well)
Shallow Monitoring Well
Intermediate Monitoring Well
Deep Monitoring Well
Monitoring Well Unknown Depth
Existing Monitoring Well Not Sampled Unknown Depth
Soil Boring
Water Supply Well
Spring
Spring Sample Location
Surface Water Sample Location
Staff Gauge
Cross-Section Lines
A-A'
B-B'
C-C'
Road
Stormwater Pipe
Bedrock High
Approximate AFFF Discharge Area
Installation Boundary
Building
Water
JORDAN AVENUE WELLFIELD INVESTIGATION AREA
FORMER NAS BRUNSWICK
BRUNSWICK, MAINE
NAVFAC
Naval Facilities Engineering Systems Command
DRAWN BY
S. PAXTON
DATE
08/05/22
CTO
N4008518F5894
CHECKED BY
J. ORIENT
DATE
10/20/22
FIGURE NUMBER
1-2

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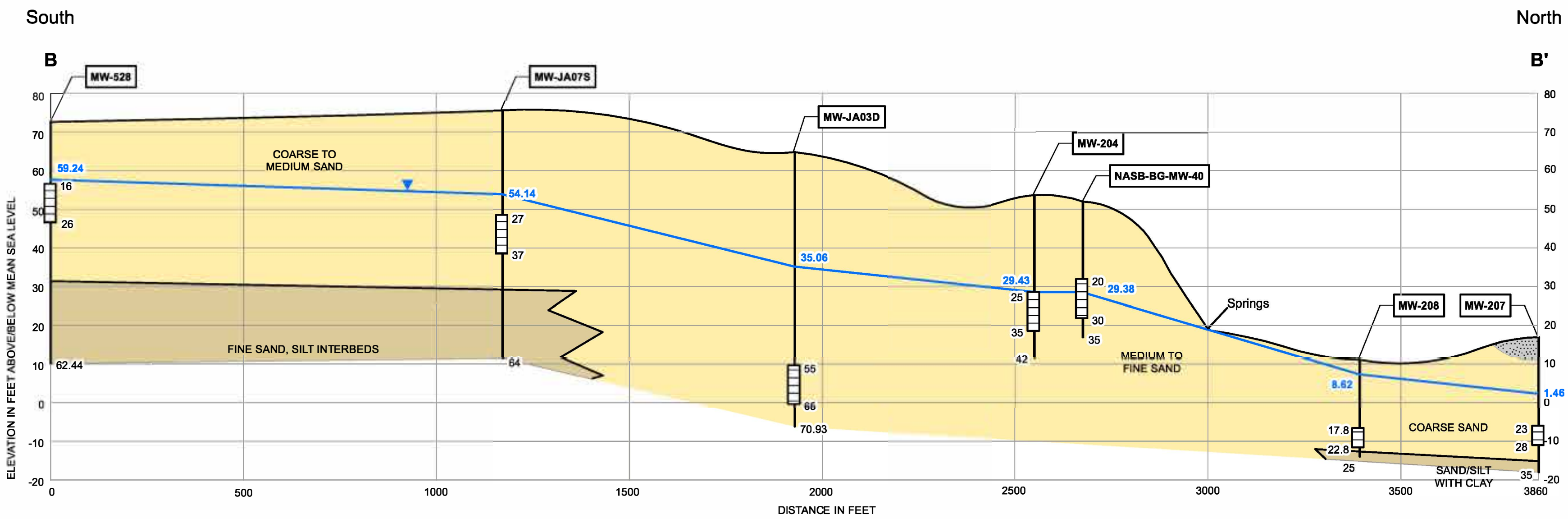

Legend

- Water Table
- 59.24 Groundwater Elevation (ft amsl)
- Monitoring Well
- 27 Boring and Screen Depth (in ft below ground surface)
- Monitoring Well Screen
- Sand
- Sand and Gravel Fill
- Transition Zone

0 300 600 Feet
HORIZONTAL

0 30 60 Feet
VERTICAL

GEOLOGIC CROSS SECTION B-B'
JORDAN AVENUE WELLFIELD INVESTIGATION AREA
FORMER NAS BRUNSWICK, MAINE

NAVFAC Naval Facilities Engineering Systems Command

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J. ENGLISH	07/22/22	N4008518F5894
CHECKED BY	DATE	FIGURE NUMBER
S. HONE	08/03/22	2-1

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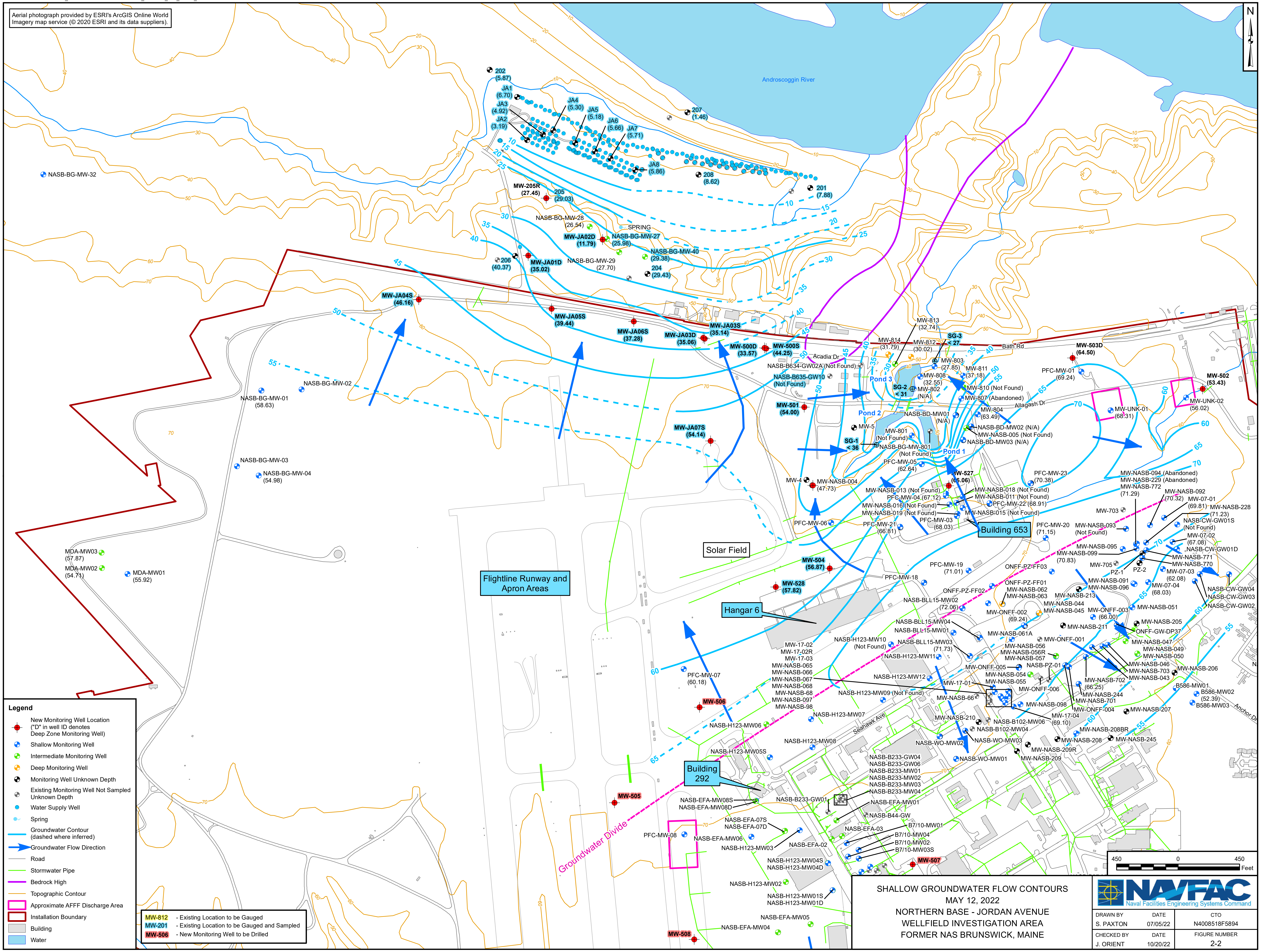

SHALLOW GROUNDWATER FLOW CONTOURS
MAY 12, 2022
NORTHERN BASE - JORDAN AVENUE
WELLFIELD INVESTIGATION AREA
FORMER NAS BRUNSWICK, MAINE

NAVFAC Naval Facilities Engineering Systems Command

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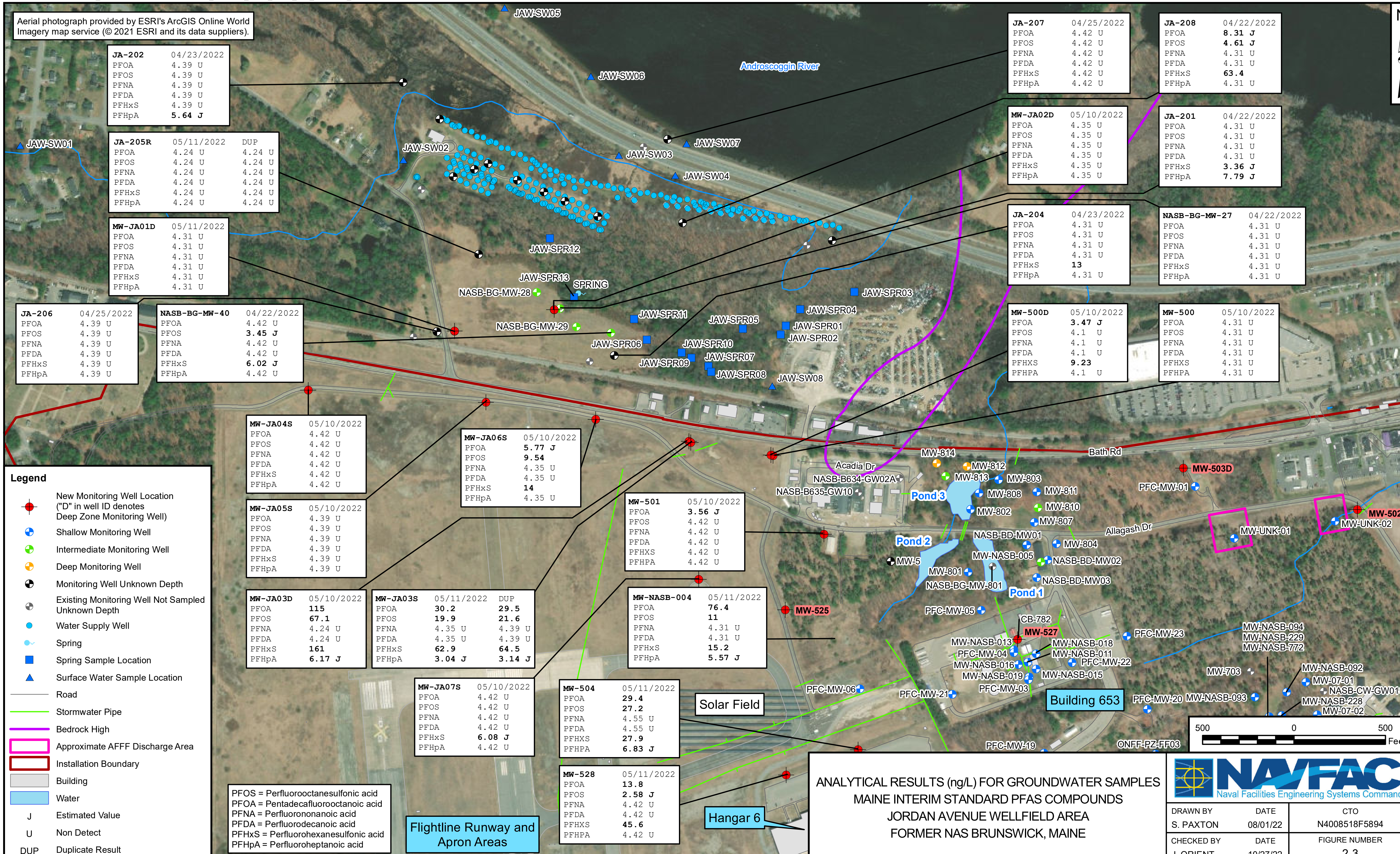

JA-202	04/23/2022
PFOA	4.39 U
PFOS	4.39 U
PFNA	4.39 U
PFDA	4.39 U
PFHxS	4.39 U
PFHpA	**5.64 J**

JA-205R	05/11/2022	DUP
PFOA	4.24 U	4.24 U
PFOS	4.24 U	4.24 U
PFNA	4.24 U	4.24 U
PFDA	4.24 U	4.24 U
PFHxS	4.24 U	4.24 U
PFHpA	4.24 U	4.24 U

MW-JA01D	05/11/2022
PFOA	4.31 U
PFOS	4.31 U
PFNA	4.31 U
PFDA	4.31 U
PFHxS	4.31 U
PFHpA	4.31 U

JA-206	04/25/2022
PFOA	4.39 U
PFOS	4.39 U
PFNA	4.39 U
PFDA	4.39 U
PFHxS	4.39 U
PFHpA	4.39 U

NASB-BG-MW-40	04/22/2022
PFOA	4.42 U
PFOS	**3.45 J**
PFNA	4.42 U
PFDA	4.42 U
PFHxS	**6.02 J**
PFHpA	4.42 U

MW-JA04S	05/10/2022
PFOA	4.42 U
PFOS	4.42 U
PFNA	4.42 U
PFDA	4.42 U
PFHxS	4.42 U
PFHpA	4.42 U

MW-JA05S	05/10/2022
PFOA	4.39 U
PFOS	4.39 U
PFNA	4.39 U
PFDA	4.39 U
PFHxS	4.39 U
PFHpA	4.39 U

MW-JA03D	05/10/2022
PFOA	**115**
PFOS	**67.1**
PFNA	4.24 U
PFDA	4.24 U
PFHxS	**161**
PFHpA	**6.17 J**

MW-JA03S	05/11/2022	DUP
PFOA	**30.2**	**29.5**
PFOS	**19.9**	**21.6**
PFNA	4.35 U	4.39 U
PFDA	4.35 U	4.39 U
PFHxS	**62.9**	**64.5**
PFHpA	**3.04 J**	**3.14 J**

MW-JA06S	05/10/2022
PFOA	**5.77 J**
PFOS	**9.54**
PFNA	4.35 U
PFDA	4.35 U
PFHxS	**14**
PFHpA	4.35 U

MW-JA07S	05/10/2022
PFOA	4.42 U
PFOS	4.42 U
PFNA	4.42 U
PFDA	4.42 U
PFHxS	**6.08 J**
PFHpA	4.42 U

MW-501	05/10/2022
PFOA	**3.56 J**
PFOS	4.42 U
PFNA	4.42 U
PFDA	4.42 U
PFHXS	4.42 U
PFHPA	4.42 U

MW-NASB-004	05/11/2022
PFOA	**76.4**
PFOS	**11**
PFNA	4.31 U
PFDA	4.31 U
PFHxS	**15.2**
PFHpA	**5.57 J**

MW-504	05/11/2022
PFOA	**29.4**
PFOS	**27.2**
PFNA	4.55 U
PFDA	4.55 U
PFHXS	**27.9**
PFHPA	**6.83 J**

MW-528	05/11/2022
PFOA	**13.8**
PFOS	**2.58 J**
PFNA	4.42 U
PFDA	4.42 U
PFHXS	**45.6**
PFHPA	4.42 U

JA-207	04/25/2022
PFOA	4.42 U
PFOS	4.42 U
PFNA	4.42 U
PFDA	4.42 U
PFHxS	4.42 U
PFHpA	4.42 U

JA-208	04/22/2022
PFOA	**8.31 J**
PFOS	**4.61 J**
PFNA	4.31 U
PFDA	4.31 U
PFHxS	**63.4**
PFHpA	4.31 U

MW-JA02D	05/10/2022
PFOA	4.35 U
PFOS	4.35 U
PFNA	4.35 U
PFDA	4.35 U
PFHxS	4.35 U
PFHpA	4.35 U

JA-201	04/22/2022
PFOA	4.31 U
PFOS	4.31 U
PFNA	4.31 U
PFDA	4.31 U
PFHxS	**3.36 J**
PFHpA	**7.79 J**

JA-204	04/23/2022
PFOA	4.31 U
PFOS	4.31 U
PFNA	4.31 U
PFDA	4.31 U
PFHxS	**13**
PFHpA	4.31 U

NASB-BG-MW-27	04/22/2022
PFOA	4.31 U
PFOS	4.31 U
PFNA	4.31 U
PFDA	4.31 U
PFHxS	4.31 U
PFHpA	4.31 U

MW-500D	05/10/2022
PFOA	**3.47 J**
PFOS	4.1 U
PFNA	4.1 U
PFDA	4.1 U
PFHXS	**9.23**
PFHPA	4.1 U

MW-500	05/10/2022
PFOA	4.31 U
PFOS	4.31 U
PFNA	4.31 U
PFDA	4.31 U
PFHXS	4.31 U
PFHPA	4.31 U

ANALYTICAL RESULTS (ng/L) FOR GROUNDWATER SAMPLES
MAINE INTERIM STANDARD PFAS COMPOUNDS
JORDAN AVENUE WELLFIELD AREA
FORMER NAS BRUNSWICK, MAINE

NAVFAC
Naval Facilities Engineering Systems Command

DRAWN BY	DATE	CTO
S. PAXTON	08/01/22	N4008518F5894
CHECKED BY	DATE	FIGURE NUMBER
J. ORIENT	10/27/22	2-3

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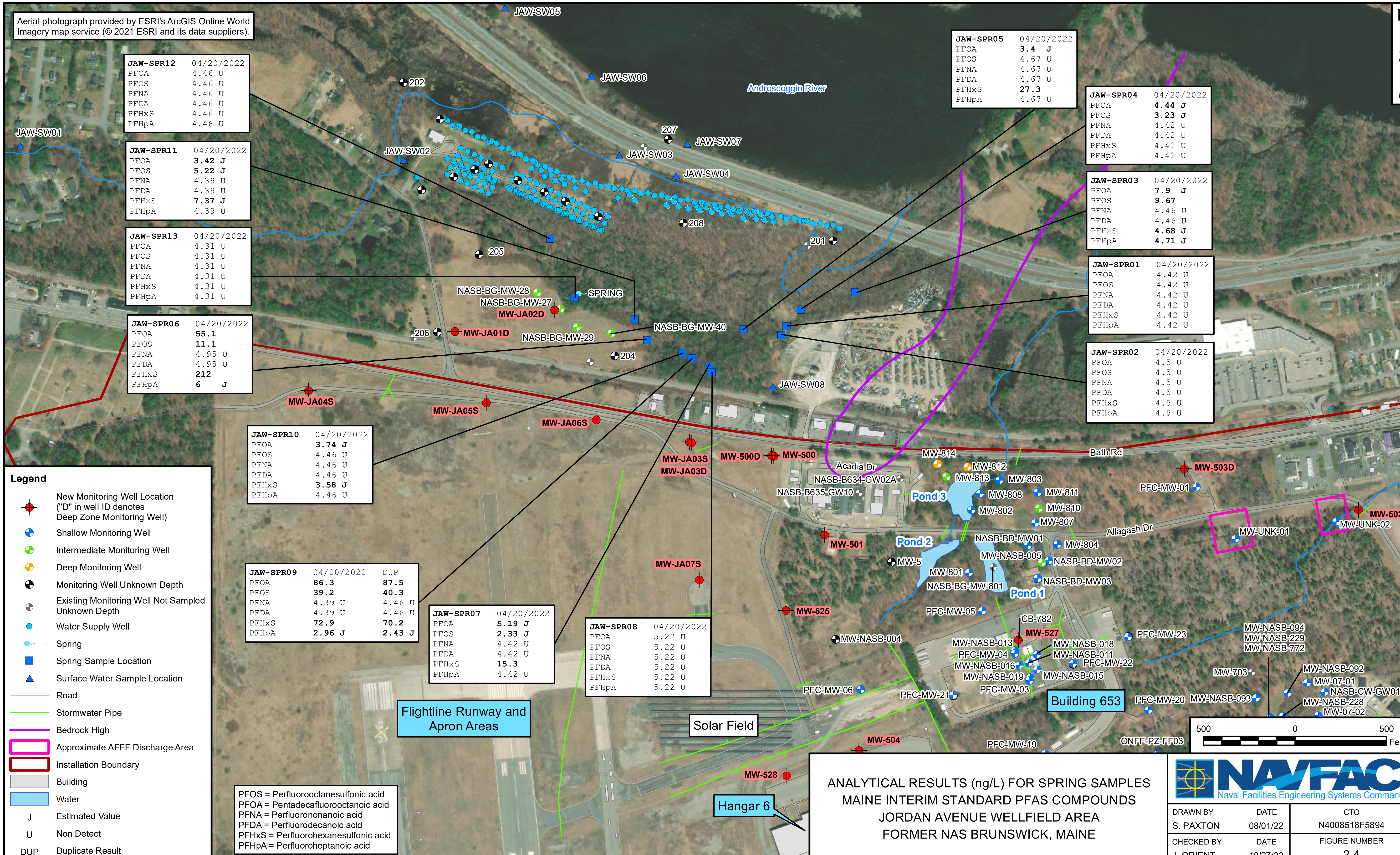

JAW-SPR12	04/20/2022
PFOA	4.46 U
PFOS	4.46 U
PFNA	4.46 U
PFDA	4.46 U
PFHxS	4.46 U
PFHpA	4.46 U

JAW-SPR11	04/20/2022
PFOA	**3.42 J**
PFOS	**5.22 J**
PFNA	4.39 U
PFDA	4.39 U
PFHxS	**7.37 J**
PFHpA	4.39 U

JAW-SPR13	04/20/2022
PFOA	4.31 U
PFOS	4.31 U
PFNA	4.31 U
PFDA	4.31 U
PFHxS	4.31 U
PFHpA	4.31 U

JAW-SPR06	04/20/2022
PFOA	**55.1**
PFOS	**11.1**
PFNA	4.95 U
PFDA	4.95 U
PFHxS	**212**
PFHpA	**6 J**

JAW-SPR10	04/20/2022
PFOA	**3.74 J**
PFOS	4.46 U
PFNA	4.46 U
PFDA	4.46 U
PFHxS	**3.58 J**
PFHpA	4.46 U

JAW-SPR09	04/20/2022	DUP
PFOA	**86.3**	**87.5**
PFOS	**39.2**	**40.3**
PFNA	4.39 U	4.46 U
PFDA	4.39 U	4.46 U
PFHxS	**72.9**	**70.2**
PFHpA	**2.96 J**	**2.43 J**

JAW-SPR07	04/20/2022
PFOA	**5.19 J**
PFOS	**2.33 J**
PFNA	4.42 U
PFDA	4.42 U
PFHxS	**15.3**
PFHpA	4.42 U

JAW-SPR08	04/20/2022
PFOA	5.22 U
PFOS	5.22 U
PFNA	5.22 U
PFDA	5.22 U
PFHxS	5.22 U
PFHpA	5.22 U

JAW-SPR05	04/20/2022
PFOA	**3.4 J**
PFOS	4.67 U
PFNA	4.67 U
PFDA	4.67 U
PFHxS	**27.3**
PFHpA	4.67 U

JAW-SPR04	04/20/2022
PFOA	**4.44 J**
PFOS	**3.23 J**
PFNA	4.42 U
PFDA	4.42 U
PFHxS	4.42 U
PFHpA	4.42 U

JAW-SPR03	04/20/2022
PFOA	**7.9 J**
PFOS	**9.67**
PFNA	4.46 U
PFDA	4.46 U
PFHxS	**4.68 J**
PFHpA	**4.71 J**

JAW-SPR01	04/20/2022
PFOA	4.42 U
PFOS	4.42 U
PFNA	4.42 U
PFDA	4.42 U
PFHxS	4.42 U
PFHpA	4.42 U

JAW-SPR02	04/20/2022
PFOA	4.5 U
PFOS	4.5 U
PFNA	4.5 U
PFDA	4.5 U
PFHxS	4.5 U
PFHpA	4.5 U

Legend

- New Monitoring Well Location ("D" in well ID denotes Deep Zone Monitoring Well)
- Shallow Monitoring Well
- Intermediate Monitoring Well
- Deep Monitoring Well
- Monitoring Well Unknown Depth
- Existing Monitoring Well Not Sampled Unknown Depth
- Water Supply Well
- Spring
- Spring Sample Location
- Surface Water Sample Location
- Road
- Stormwater Pipe
- Bedrock High
- Approximate AFFF Discharge Area
- Installation Boundary
- Building
- Water
- J Estimated Value
- U Non Detect
- DUP Duplicate Result

PFOS = Perfluorooctanesulfonic acid
PFOA = Pentadecafluorooctanoic acid
PFNA = Perfluorononanoic acid
PFDA = Perfluorodecanoic acid
PFHxS = Perfluorohexanesulfonic acid
PFHpA = Perfluoroheptanoic acid

ANALYTICAL RESULTS (ng/L) FOR SPRING SAMPLES
MAINE INTERIM STANDARD PFAS COMPOUNDS
JORDAN AVENUE WELLFIELD AREA
FORMER NAS BRUNSWICK, MAINE

NAVFAC Naval Facilities Engineering Systems Command

DRAWN BY	DATE	CTO
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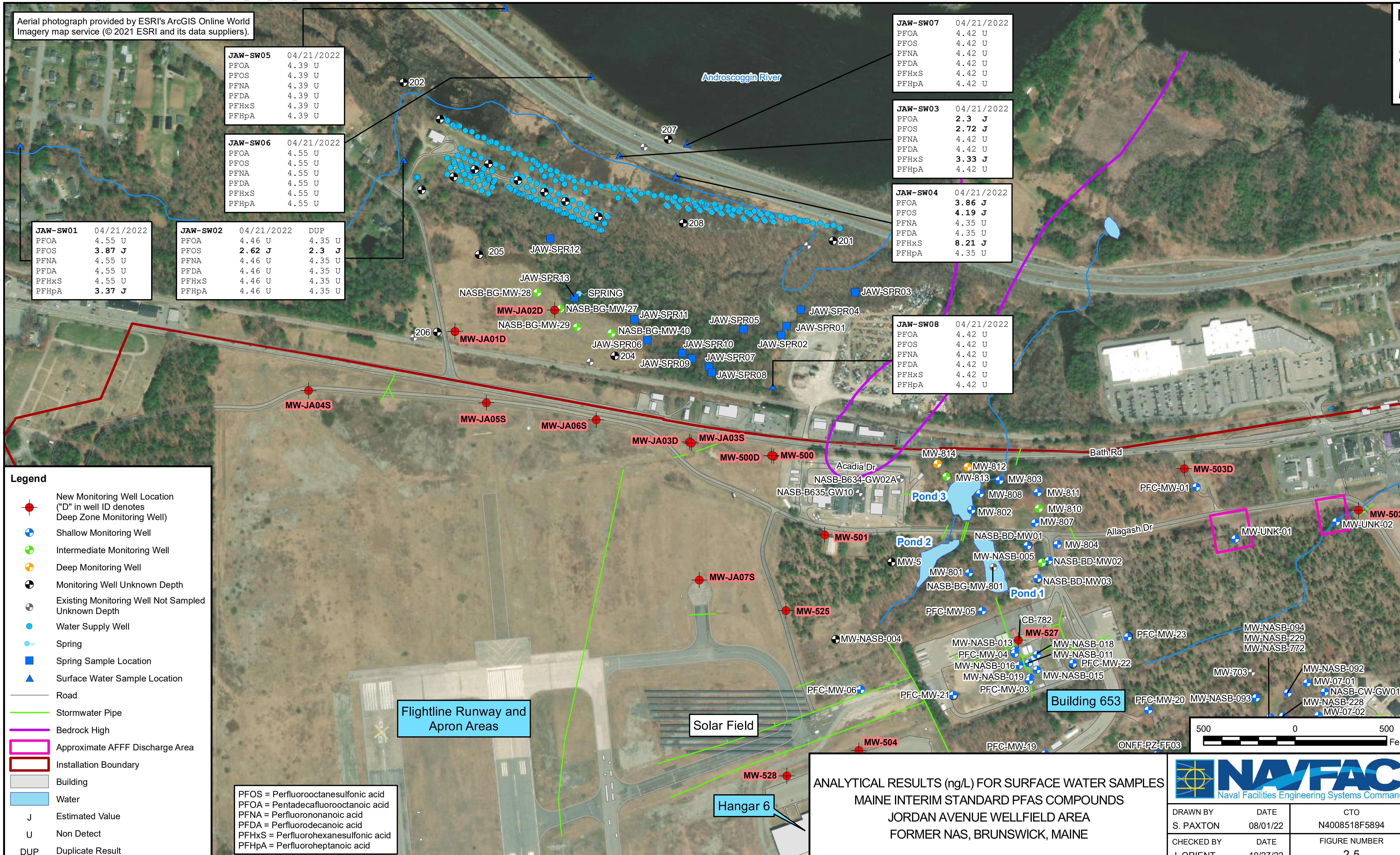
CHECKED BY	DATE	FIGURE NUMBER
J. ORIENT	10/27/22	2-4



JAW-SW01	04/21/2022
PFOA	4.55 U
PFOS	**3.87 J**
PFNA	4.55 U
PFDA	4.55 U
PFHxS	4.55 U
PFHpA	**3.37 J**

JAW-SW02	04/21/2022	DUP
PFOA	4.46 U	4.35 U
PFOS	**2.62 J**	**2.3 J**
PFNA	4.46 U	4.35 U
PFDA	4.46 U	4.35 U
PFHxS	4.46 U	4.35 U
PFHpA	4.46 U	4.35 U

JAW-SW03	04/21/2022
PFOA	**2.3 J**
PFOS	**2.72 J**
PFNA	4.42 U
PFDA	4.42 U
PFHxS	**3.33 J**
PFHpA	4.42 U

JAW-SW04	04/21/2022
PFOA	**3.86 J**
PFOS	**4.19 J**
PFNA	4.35 U
PFDA	4.35 U
PFHxS	**8.21 J**
PFHpA	4.35 U

JAW-SW05	04/21/2022
PFOA	4.39 U
PFOS	4.39 U
PFNA	4.39 U
PFDA	4.39 U
PFHxS	4.39 U
PFHpA	4.39 U

JAW-SW06	04/21/2022
PFOA	4.55 U
PFOS	4.55 U
PFNA	4.55 U
PFDA	4.55 U
PFHxS	4.55 U
PFHpA	4.55 U

JAW-SW07	04/21/2022
PFOA	4.42 U
PFOS	4.42 U
PFNA	4.42 U
PFDA	4.42 U
PFHxS	4.42 U
PFHpA	4.42 U

JAW-SW08	04/21/2022
PFOA	4.42 U
PFOS	4.42 U
PFNA	4.42 U
PFDA	4.42 U
PFHxS	4.42 U
PFHpA	4.42 U

Legend

- New Monitoring Well Location ("D" in well ID denotes Deep Zone Monitoring Well)
- Shallow Monitoring Well
- Intermediate Monitoring Well
- Deep Monitoring Well
- Monitoring Well Unknown Depth
- Existing Monitoring Well Not Sampled Unknown Depth
- Water Supply Well
- Spring
- Spring Sample Location
- Surface Water Sample Location
- Road
- Stormwater Pipe
- Bedrock High
- Approximate AFFF Discharge Area
- Installation Boundary
- Building
- Water
- J Estimated Value
- U Non Detect
- DUP Duplicate Result

PFOS = Perfluorooctanesulfonic acid
PFOA = Pentadecafluorooctanoic acid
PFNA = Perfluorononanoic acid
PFDA = Perfluorodecanoic acid
PFHxS = Perfluorohexanesulfonic acid
PFHpA = Perfluoroheptanoic acid

ANALYTICAL RESULTS (ng/L) FOR SURFACE WATER SAMPLES
MAINE INTERIM STANDARD PFAS COMPOUNDS
JORDAN AVENUE WELLFIELD AREA
FORMER NAS, BRUNSWICK, MAINE

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CHECKED BY	DATE	FIGURE NUMBER
J. ORIENT	10/27/22	2-5

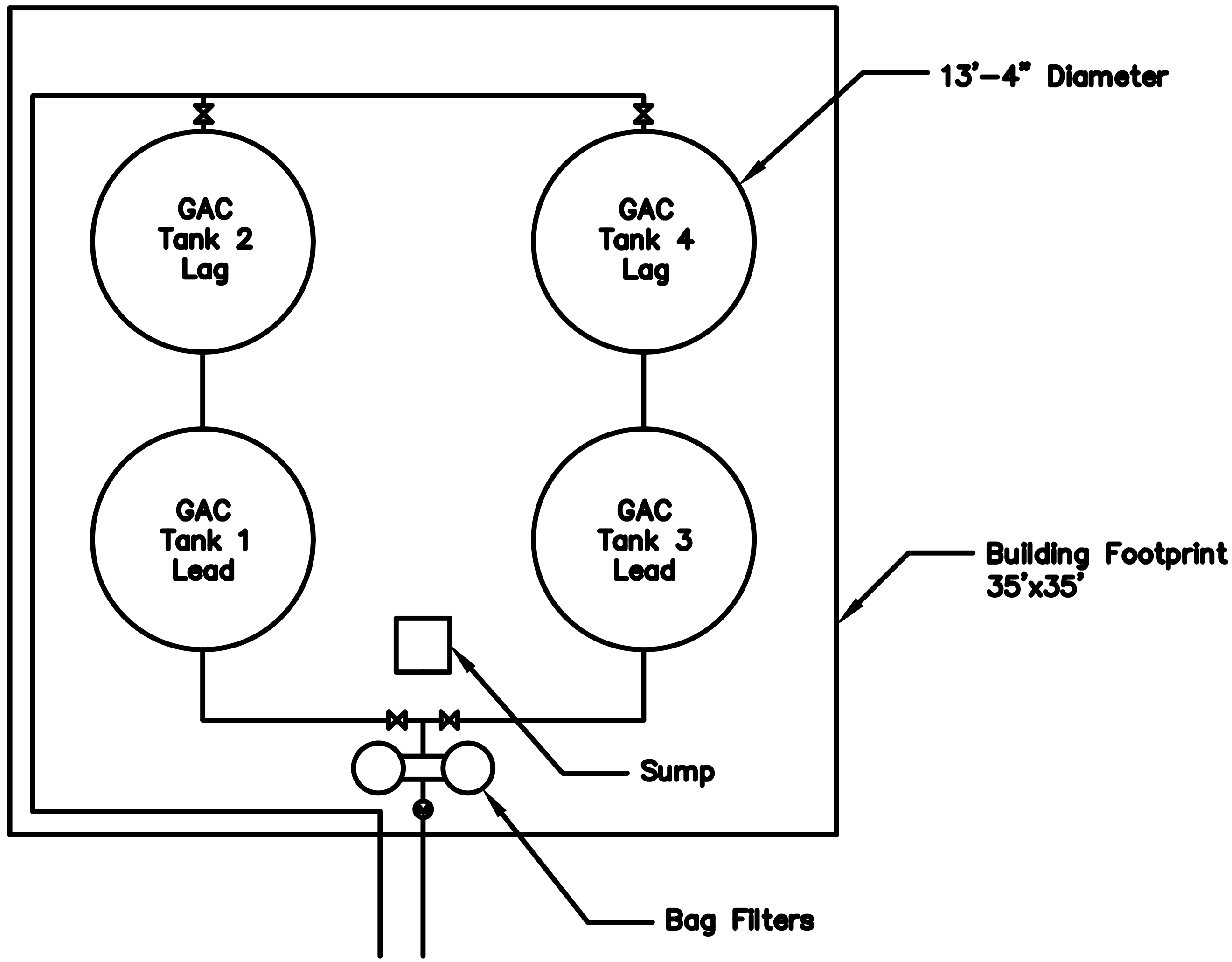
SITE PLAN

GROUNDWATER EXTRACTION & TREATMENT SYSTEM
JORDAN WELLFIELD TREATMENT SYSTEM
BRUNSWICK, MAINE

SCALE: 1"=30'	
FILE	
REV 0	DATE 9/13/22
EXHIBIT NUMBER FIGURE 5-1	

LEGEND

8-INCH GATE VALVE
WATER METER



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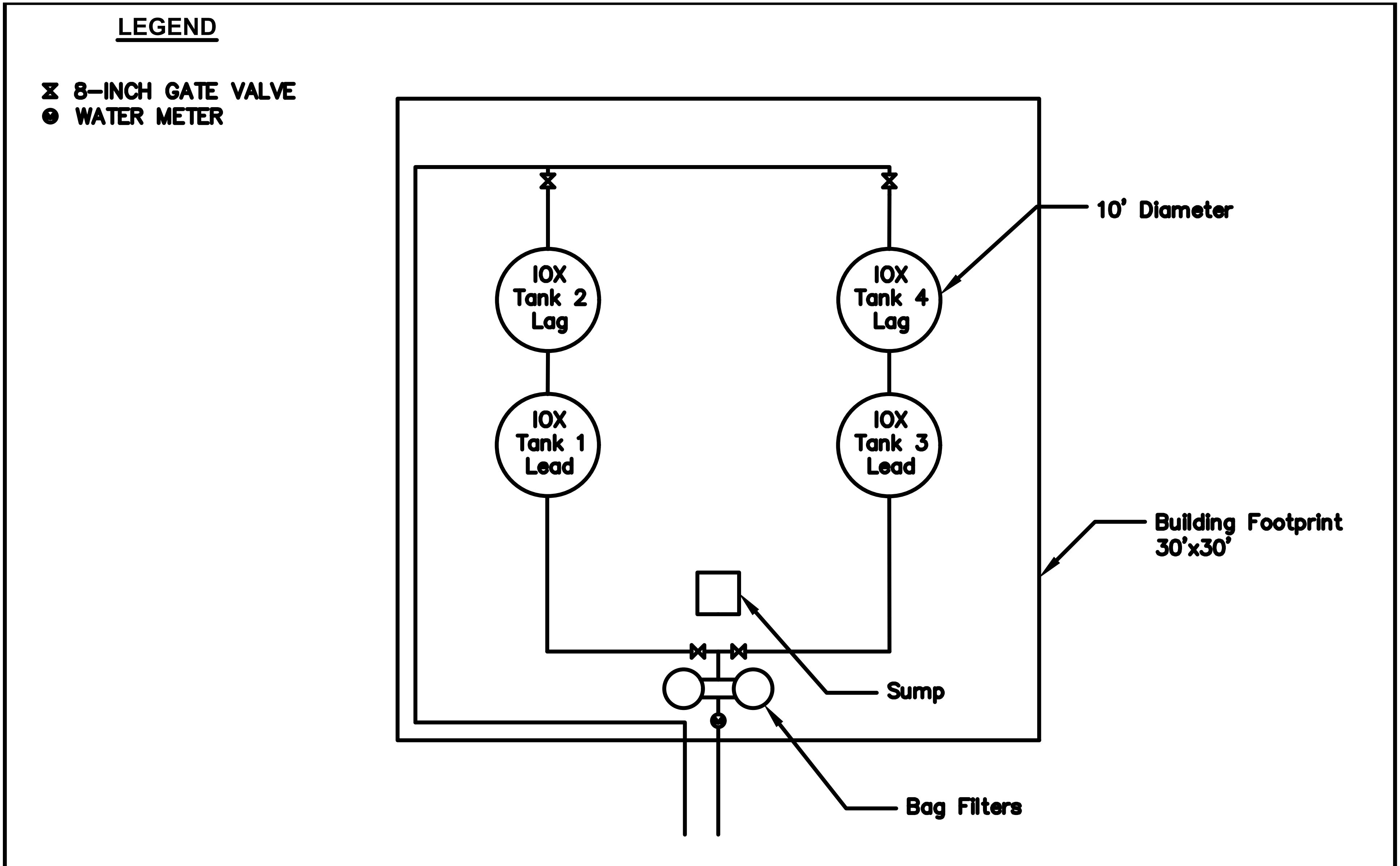
ALTERNATIVE 2 FACILITY LAYOUT

GROUNDWATER EXTRACTION & TREATMENT SYSTEM
JORDAN WELLFIELD TREATMENT SYSTEM
BRUNSWICK, MAINE

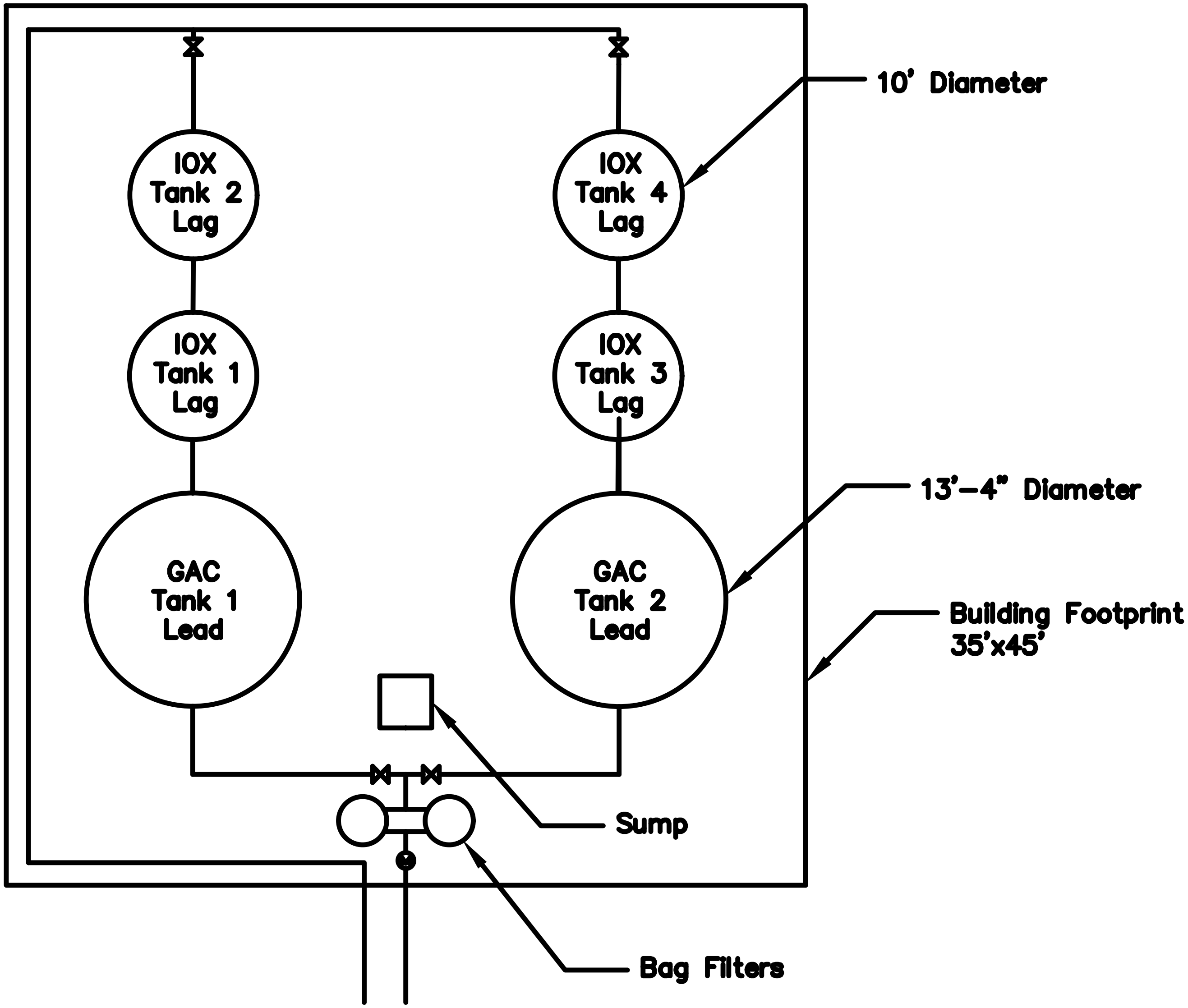
SCALE: 1" = 20'	
FILE	
REV 0	DATE 9/13/22
EXHIBIT NUMBER FIGURE 5-2	



ALTERNATIVE 3 FACILITY LAYOUT	SCALE: N.T.S.
GROUNDWATER EXTRACTION & TREATMENT SYSTEM JORDAN WELLFIELD TREATMENT SYSTEM BRUNSWICK, MAINE	FILE
	REV 0 DATE 9/13/22
	EXHIBIT NUMBER FIGURE 5-3

LEGEND

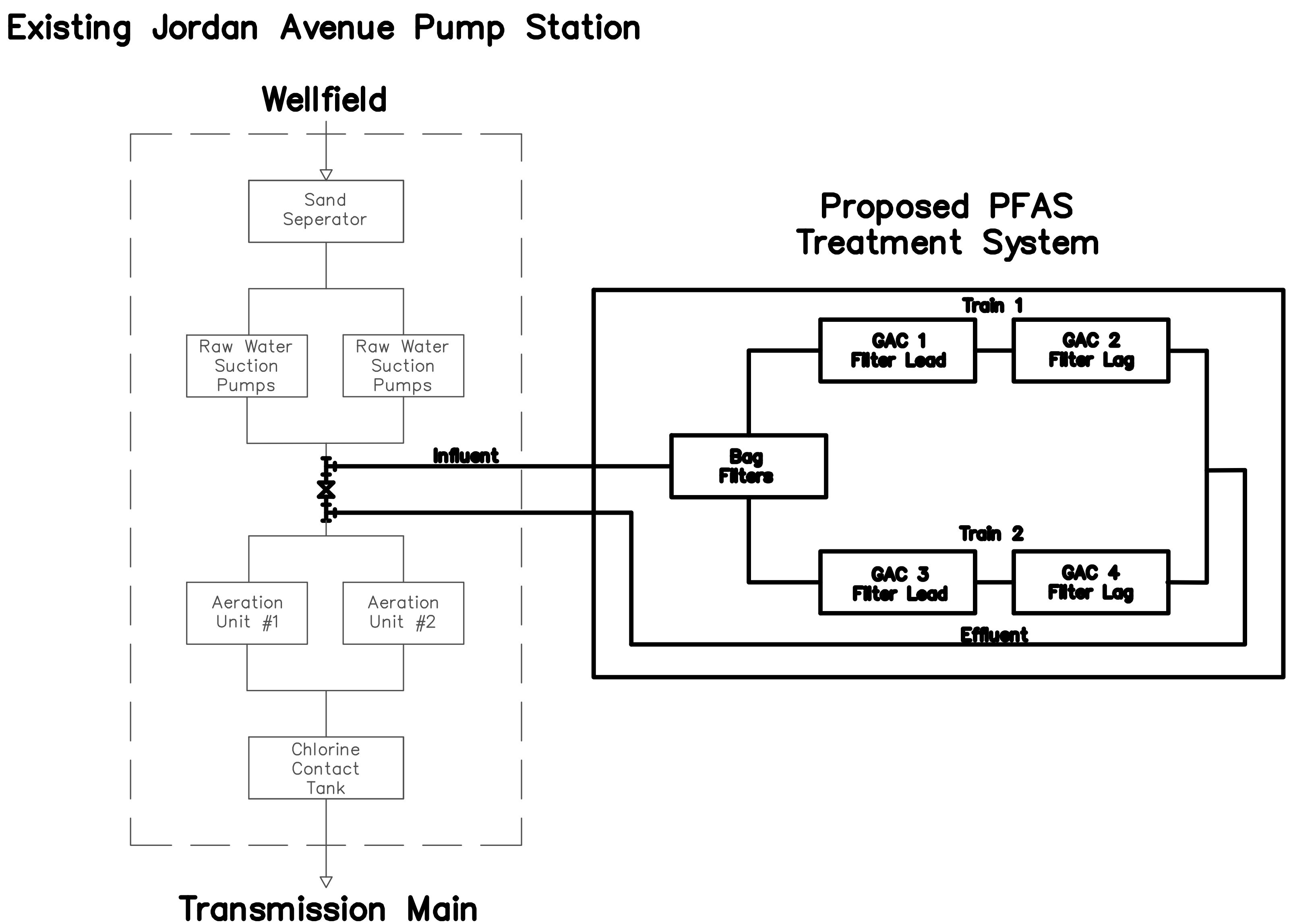
- 8–INCH GATE VALVE
- WATER METER



ALTERNATIVE 4 FACILITY LAYOUT

GROUNDWATER EXTRACTION & TREATMENT SYSTEM
JORDAN WELLFIELD TREATMENT SYSTEM
BRUNSWICK, MAINE

SCALE: 1" = 20'	
FILE	
REV 0	DATE 9/13/22
EXHIBIT NUMBER FIGURE 5-4	



NAVFAC

ALTERNATIVE 2 PROCESS FLOW DIAGRAM

GROUNDWATER EXTRACTION & TREATMENT SYSTEM
JORDAN WELLFIELD TREATMENT SYSTEM
BRUNSWICK, MAINE

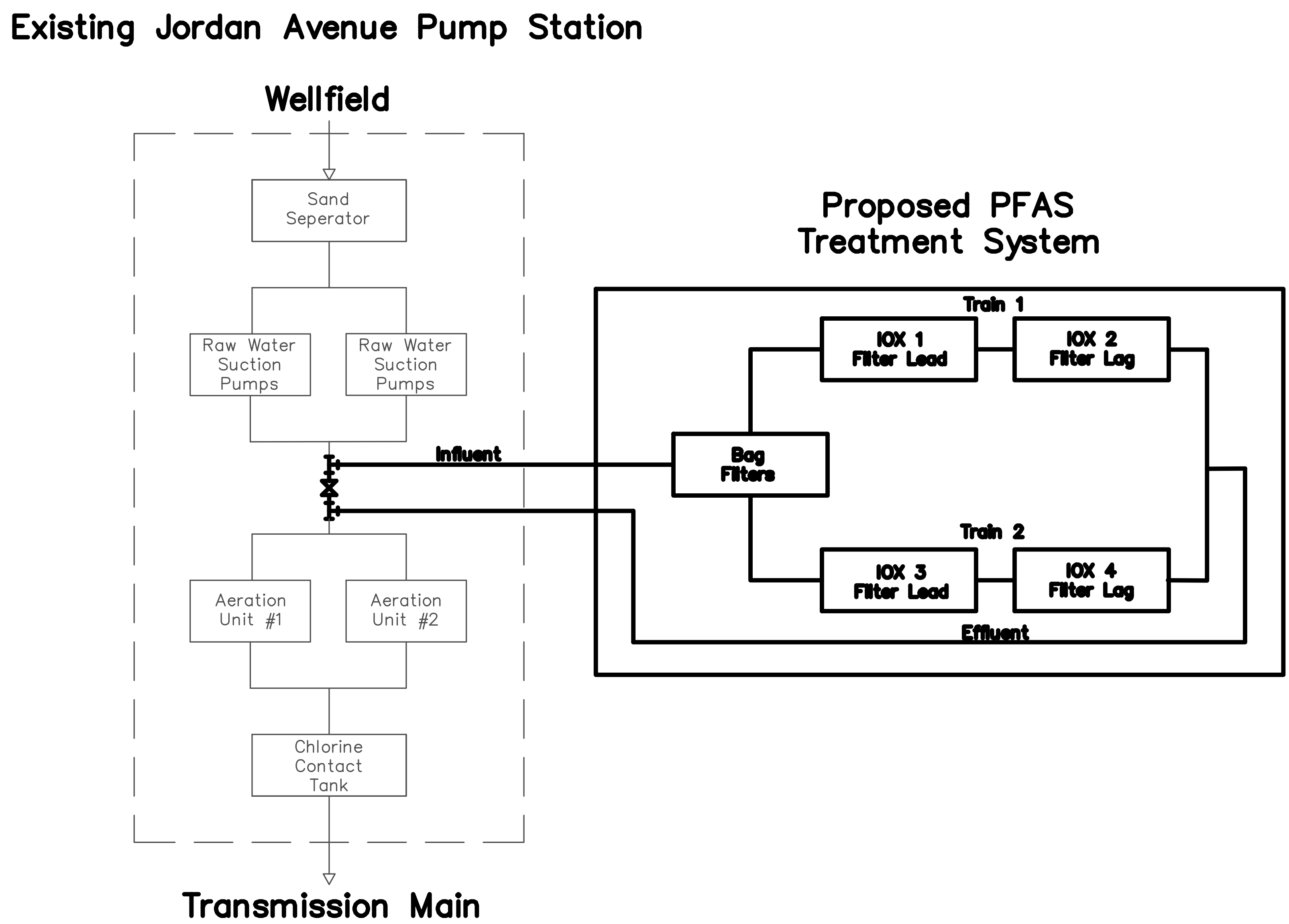
SCALE: 1" = 20'

FILE

REV 0

DATE 9/13/22

EXHIBIT NUMBER
FIGURE 5-5

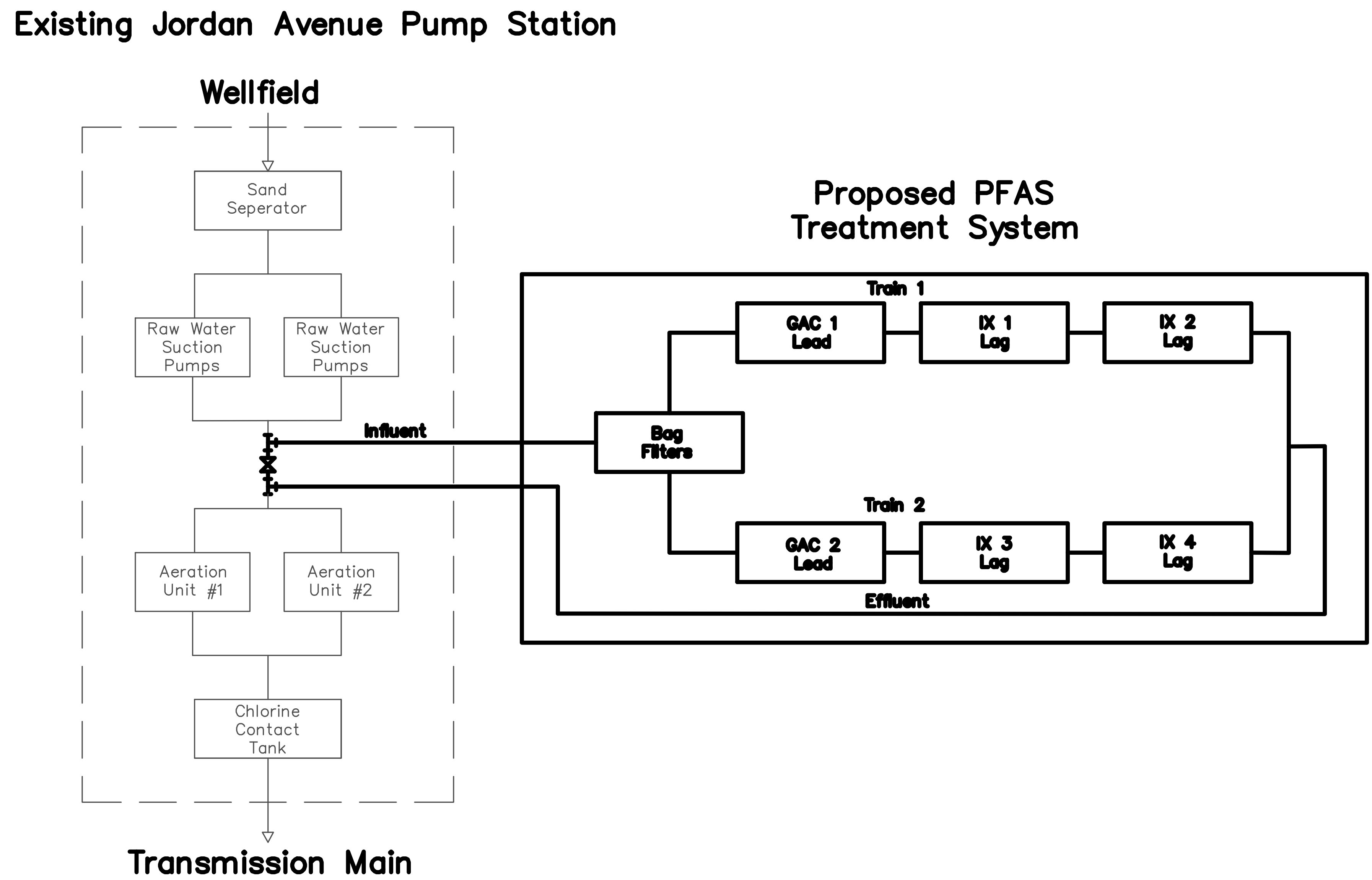


NAVFAC

ALTERNATIVE 3 PROCESS FLOW DIAGRAM

GROUNDWATER EXTRACTION & TREATMENT SYSTEM
JORDAN WELLFIELD TREATMENT SYSTEM
BRUNSWICK, MAINE

SCALE: 1" = 20'	
FILE	
REV 0	DATE 9/13/22
EXHIBIT NUMBER	FIGURE 5-6



NAVFAC	ALTERNATIVE 4 PROCESS FLOW DIAGRAM GROUNDWATER EXTRACTION & TREATMENT SYSTEM JORDAN WELLFIELD TREATMENT SYSTEM BRUNSWICK, MAINE	SCALE: 1" = 20' FILE REV 0 DATE 9/13/22 EXHIBIT NUMBER FIGURE 5-7

APPENDIX A
COST ESTIMATE

Table A-1: GAC Cost Summary Sheet		
Description		**Totals**
Mobilization/Demobilization (6% of Construction Cost)	$	140,609.87
Connection to Existing Pump Station	$	24,049.10
Conveyance Piping	$	41,717.68
Water Treatment Piping & Appurtenances	$	87,173.45
Backwash	$	54,524.00
Building Construction	$	277,443.11
Erosion & Sediment Control, Earthwork, and Site Improvements	$	43,340.50
Electrical & Instrumentation	$	233,250.00
GAC System	$	1,582,000.00
Contingency (30%)	$	745,232.31
Grand Total	**$**	**3,229,340.03**
Annual O&M (Years 1 & 2)	**$**	**340,592.03**
Annual O&M (Years 3 - 30)	**$**	**318,592.03**
One 1000 GPM Treatment System Net Present Worth (30-Year)	**$**	**12,127,976.29**

Table A-2: Ion Exchange Cost Summary Sheet		
Description	**Totals**	
Mobilization/Demobilization (6% of Construction Cost)	$	129,625.90
Connection to Existing Pump Station	$	24,049.10
Conveyance Piping	$	41,717.68
Water Treatment Piping & Appurtenances	$	87,173.45
Backwash	$	37,043.00
Building Construction	$	241,271.91
Erosion & Sediment Control, Earthwork, and Site Improvements	$	43,340.50
Electrical & Instrumentation	$	153,250.00
Ion Exchange	$	1,532,586.04
Contingency (30%)	$	687,017.28
Grand Total	**$**	**2,977,074.86**
Annual O&M (Years 1 & 2)	**$**	**115,742.03**
Annual O&M (Years 3 - 30)	**$**	**93,742.03**
One 1000 GPM Treatment System Net Present Worth (30-Year)	**$**	**5,626,218.08**

Table A-3: GAC & Ion Exchange Cost Summary Sheet		
Description		**Totals**
Mobilization/Demobilization (6% of Construction Cost)	$	181,479.59
Connection to Existing Pump Station	$	24,049.10
Conveyance Piping	$	41,717.68
Water Treatment Piping & Appurtenances	$	87,173.45
Backwash	$	37,043.00
Building Construction	$	313,400.07
Erosion & Sediment Control, Earthwork, and Site Improvements	$	43,340.50
Electrical & Instrumentation	$	153,250.00
Ion Exchange and GAC Treatment	$	2,324,686.04
Contingency (30%)	$	961,841.83
Grand Total	**$**	**4,167,981.26**
Annual O&M (Years 1 & 2)	**$**	**238,542.03**
Annual O&M (Years 3 - 30)	**$**	**225,742.03**
One 1000 GPM Treatment System Net Present Worth (30-Year)	**$**	**10,467,676.70**

Table A-4: GAC Construction Cost Estimate				
Description	**Units**	**Unit Price**	**Quantity**	**Totals**
Mobilization/Demobilization (6% of Construction Cost)	EA	$ 140,609.87	1	$ 140,609.87
Connection to Existing Pump Station				
8" DI Gate Valve	EA	$ 4,773.85	3	$ 14,321.54
8x8x8" DI Tee	EA	$ 1,591.84	2	$ 3,183.67
8" Ductile Iron 90 Elbow	EA	$ 936.42	1	$ 936.42
Pipe Support	EA	$ 131.96	6	$ 791.78
Wall Core & Link Seals	EA	$ 848.63	2	$ 1,697.25
8" Ductile Iron Pipe	LF	$ 103.95	30	$ 3,118.44
Conveyance Piping				
Expansion Joint	EA	$ 2,959.41	2	$ 5,918.82
Insulation & Heating Elements	LF	$ 86.88	10	$ 868.79
8" Ductile Iron 90 Elbow	EA	$ 936.42	4	$ 3,745.66
8" Ductile Iron Pipe	LF	$ 103.95	300	$ 31,184.40
Water Treatment Piping & Appurtenances				
8" Ductile Iron Pipe	LF	$ 103.95	80	$ 8,315.84
8x8x8" DI Tee	EA	$ 1,591.84	2	$ 3,183.67
Expansion Joint	EA	$ 2,959.41	5	$ 14,797.06
8" Check Valve	EA	$ 3,147.22	1	$ 3,147.22
8" Gate Valve	EA	$ 4,773.85	7	$ 33,416.93
4" Water Meter	EA	$ 5,997.43	1	$ 5,997.43
6" to 8" Increaser	EA	$ 3,058.30	4	$ 12,233.21
8" Ductile Iron 90 Elbow	EA	$ 936.42	6	$ 5,618.50
Sump Pump	EA	$ 463.59	1	$ 463.59
Backwash				
Frac Tank	EA	$ 12,975.00	2	$ 25,950.00
20 HP Pump	EA	$ 4,207.00	1	$ 4,207.00
6" Flexible Hosing	LF	$ 243.67	100	$ 24,367.00
Building Construction				
Site Grading	LS	$ 130,000.00	1	$ 130,000.00
Foundation	CY	$ 432.85	90	$ 38,956.32
Prefab Metal Building	EA	$ 78.00	1225	$ 95,550.00
Roll-up Door	EA	$ 12,936.79	1	$ 12,936.79
Erosion & Sediment Control, Earthwork, and Site Improvements				
Temporary Road, Gravel fill, 8" Gravel Depth, excl surfacing	SY	$ 58.50	160	$ 9,360.00
Access Road	TON	$ 40.00	40	$ 1,600.00
Silt Fence	LF	$ 8.00	180	$ 1,440.00
Tree Removal	EA	$ 6,042.40	5	$ 30,212.00
Tree Protection	EA	$ 7.85	10	$ 78.50
Fine Grading and Seeding	SY	$ 6.50	100	$ 650.00
Electrical & Instrumentation				
Building Electrical	EA	$ 160,000.00	1	$ 160,000.00
Electrical Connection to Existing	EA	$ 61,250.00	1	$ 61,250.00
Instrumentation	EA	$ 12,000.00	1	$ 12,000.00
GAC System	EA	$ 780,000.00	2	$ 1,560,000.00
Fluorosorb	CF	$ 200.00	110	$ 22,000.00
Subtotal (Excluding Mobilization/Demobilization)				$ 2,343,497.84
Subtotal (Including Mobilization/Demobilization)				$ 2,484,107.71
30% Contingency				$ 745,232.31
Grand Total				$ 3,229,340.03

Table A-5: Ion Exchange Construction Cost Estimate				
Description	**Units**	**Unit Price**	**Quantity**	**Totals**
Mobilization/Demobilization (6% of Construction Cost)	EA	$ 129,625.90	1	$ 129,625.90
Connection to Existing Pump Station				
8" DI Gate Valve	EA	$ 4,773.85	3	$ 14,321.54
8x8x8" DI Tee	EA	$ 1,591.84	2	$ 3,183.67
8" Ductile Iron 90 Elbow	EA	$ 936.42	1	$ 936.42
Pipe Support	EA	$ 131.96	6	$ 791.78
Wall Core & Link Seals	EA	$ 848.63	2	$ 1,697.25
8" Ductile Iron Pipe	LF	$ 103.95	30	$ 3,118.44
Conveyance Piping				
Expansion Joint	EA	$ 2,959.41	2	$ 5,918.82
Insulation & Heating Elements	LF	$ 86.88	10	$ 868.79
8" Ductile Iron 90 Elbow	EA	$ 936.42	4	$ 3,745.66
8" Ductile Iron Pipe	LF	$ 103.95	300	$ 31,184.40
Water Treatment Piping & Appurtenances				
8" Ductile Iron Pipe	LF	$ 103.95	80	$ 8,315.84
8x8x8" DI Tee	EA	$ 1,591.84	2	$ 3,183.67
Expansion Joint	EA	$ 2,959.41	5	$ 14,797.06
8" Check Valve	EA	$ 3,147.22	1	$ 3,147.22
8" Gate Valve	EA	$ 4,773.85	7	$ 33,416.93
4" Water Meter	EA	$ 5,997.43	1	$ 5,997.43
6" to 8" Increaser	EA	$ 3,058.30	4	$ 12,233.21
8" Ductile Iron 90 Elbow	EA	$ 936.42	6	$ 5,618.50
Sump Pump	EA	$ 463.59	1	$ 463.59
Backwash				
Frac Tank	EA	$ 12,975.00	2	$ 25,950.00
20 HP Pump	EA	$ 4,207.00	1	$ 4,207.00
10 HP Pump	EA	$ 2,404.00	1	$ 2,404.00
6" Flexible Hosing	LF	$ 44.82	100	$ 4,482.00
Building Construction				
Site Grading	LS	$ 130,000.00	1	$ 130,000.00
Foundation	CY	$ 432.85	65	$ 28,135.12
Prefab Metal Building	EA	$ 78.00	900	$ 70,200.00
Roll-up Door	EA	$ 12,936.79	1	$ 12,936.79
Erosion & Sediment Control, Earthwork, and Site Improvements				
Temporary Road, Gravel fill, 8" Gravel Depth, excl surfacing	SY	$ 58.50	160	$ 9,360.00
Access Road	TON	$ 40.00	40	$ 1,600.00
Silt Fence	LF	$ 8.00	180	$ 1,440.00
Tree Removal	EA	$ 6,042.40	5	$ 30,212.00
Tree Protection	EA	$ 7.85	10	$ 78.50
Fine Grading and Seeding	SY	$ 6.50	100	$ 650.00
Electrical & Instrumentation				
Building Electrical	EA	$ 80,000.00	1	$ 80,000.00
Electrical Connection to Existing	EA	$ 61,250.00	1	$ 61,250.00
Instrumentation	EA	$ 12,000.00	1	$ 12,000.00
Ion Exchange & GAC Treatment				
Tank System	EA	$ 669,000.00	2	$ 1,338,000.00
PFAS Single Use Resin	CF	$ 250.00	700	$ 175,000.00
Fluorosorb	TON	$ 90.00	110	$ 9,900.00
Valve Tree (8-inch)	EA	$ 9,686.04	1	$ 9,686.04
Subtotal (Excluding Mobilization/Demobilization)				$ 2,160,431.68
Subtotal (Including Mobilization/Demobilization)				$ 2,290,057.58
30% Contingency				$ 687,017.28
Grand Total				$ 2,977,074.86

Table A-6: GAC & Ion Exchange Construction Cost Estimate				
Description	**Units**	**Unit Price**	**Quantity**	**Totals**
Mobilization/Demobilization (6% of Construction Cost)	EA	$ 181,479.59	1	$ 181,479.59
Connection to Existing Pump Station				
8" DI Gate Valve	EA	$ 4,773.85	3	$ 14,321.54
8x8x8" DI Tee	EA	$ 1,591.84	2	$ 3,183.67
8" Ductile Iron 90 Elbow	EA	$ 936.42	1	$ 936.42
Pipe Support	EA	$ 131.96	6	$ 791.78
Wall Core & Link Seals	EA	$ 848.63	2	$ 1,697.25
8" Ductile Iron Pipe	LF	$ 103.95	30	$ 3,118.44
Conveyance Piping				
Expansion Joint	EA	$ 2,959.41	2	$ 5,918.82
Insulation & Heating Elements	LF	$ 86.88	10	$ 868.79
8" Ductile Iron 90 Elbow	EA	$ 936.42	4	$ 3,745.66
8" Ductile Iron Pipe	LF	$ 103.95	300	$ 31,184.40
Water Treatment Piping & Appurtenances				
8" Ductile Iron Pipe	LF	$ 103.95	80	$ 8,315.84
8x8x8" DI Tee	EA	$ 1,591.84	2	$ 3,183.67
Expansion Joint	EA	$ 2,959.41	5	$ 14,797.06
8" Check Valve	EA	$ 3,147.22	1	$ 3,147.22
8" Gate Valve	EA	$ 4,773.85	7	$ 33,416.93
4" Water Meter	EA	$ 5,997.43	1	$ 5,997.43
6" to 8" Increaser	EA	$ 3,058.30	4	$ 12,233.21
8" Ductile Iron 90 Elbow	EA	$ 936.42	6	$ 5,618.50
Sump Pump	EA	$ 463.59	1	$ 463.59
Backwash				
Frac Tank	EA	$ 12,975.00	2	$ 25,950.00
20 HP Pump	EA	$ 4,207.00	1	$ 4,207.00
10 HP Pump	EA	$ 2,404.00	1	$ 2,404.00
6" Flexible Hosing	LF	$ 44.82	100	$ 4,482.00
Building Construction				
Site Grading	LS	$ 130,000.00	1	$ 130,000.00
Foundation	CY	$ 432.85	110	$ 47,613.28
Prefab Metal Building	EA	$ 78.00	1575	$ 122,850.00
Roll-up Door	EA	$ 12,936.79	1	$ 12,936.79
Erosion & Sediment Control, Earthwork, and Site Improvements				
Temporary Road, Gravel fill, 8" Gravel Depth, excl surfacing	SY	$ 58.50	160	$ 9,360.00
Access Road	TON	$ 40.00	40	$ 1,600.00
Silt Fence	LF	$ 8.00	180	$ 1,440.00
Tree Removal	EA	$ 6,042.40	5	$ 30,212.00
Tree Protection	EA	$ 7.85	10	$ 78.50
Fine Grading and Seeding	SY	$ 6.50	100	$ 650.00
Electrical & Instrumentation				
Building Electrical	EA	$ 80,000.00	1	$ 80,000.00
Electrical Connection to Existing	EA	$ 61,250.00	1	$ 61,250.00
Instrumentation	EA	$ 12,000.00	1	$ 12,000.00
Ion Exchange & GAC Treatment				
GAC-Calgon M12-40 Single System	EA	$ 390,000.00	2	$ 780,000.00
Tank System	EA	$ 669,000.00	2	$ 1,338,000.00
PFAS Single Use Resin	CF	$ 250.00	700	$ 175,000.00
Fluorosorb	CF	$ 200.00	110	$ 22,000.00
Valve Tree (8-inch)	EA	$ 9,686.04	1	$ 9,686.04
Subtotal (Excluding Mobilization/Demobilization)				$ 3,024,659.84
Subtotal (Including Mobilization/Demobilization)				$ 3,206,139.43
30% Contingency				$ 961,841.83
Grand Total				$ 4,167,981.26

Table A-7: GAC O&M Costs (30 Years)				
Description	**Units**	**Unit Price**	**Quantity**	**Totals**
Felt Filter Bags (Bi-weekly Changeout)	EA	$ 4.75	52	$ 247.00
GAC Removal and Disposal (Annually)	LB	$ 2.75	80000	$ 220,000.00
PFAS Regenerable Resin Replacement (Every Other Year)	CF	$ 80.00	160	$ 12,800.00
Fluorosorb Replacement (Annually)	CF	$ 200.00	110	$ 22,000.00
Equipment/Pump Maintenance (Annually)	LS	$ 55,545.03	1	$ 55,545.03
O&M, Sampling and Analysis (Monthly)	Events	$ 2,500.00	12	$ 30,000.00
			Cost per Year (Years 1 & 2)	$ 340,592.03
			Cost per Year (Year 3 - 30)	$ 318,592.03
			Total Cost (30 Years)	$ 12,127,976.29

Table A-8: Ion Exchange O&M Costs (30 Years)				
Description	**Units**	**Unit Price**	**Quantity**	**Totals**
Felt Filter Bags (Bi-weekly Changeout)	EA	$ 4.75	52	$ 247.00
Equipment/Pump Maintenance (Annually)	LS	$ 55,545.03	1	$ 55,545.03
Fluorosorb Replacement (Annually)	CF	$ 200.00	110	$ 22,000.00
Resin Removal and Disposal (Every Other Year)	LS	$ 7,950.00	1	$ 7,950.00
O&M, Sampling and Analysis (Monthly)	Events	$ 2,500.00	12	$ 30,000.00
			Cost per Year (Years 1 & 2)	$ 115,742.03
			Cost per Year (Year 3 - 30)	$ 93,742.03
			Total Cost (30 Years)	$ 5,626,218.08

Table A-9: GAC & Ion Exchange O&M Costs (30 Years)				
Description	**Units**	**Unit Price**	**Quantity**	**Totals**
Felt Filter Bags (Bi-weekly Changeout)	EA	$ 4.75	52	$ 247.00
GAC Removal and Disposal (Annually)	LB	$ 2.75	40000	$ 110,000.00
Fluorosorb Replacement (Annually)	CF	$ 200.00	110	$ 22,000.00
Equipment/Pump Maintenance (Annually)	LS	$ 55,545.03	1	$ 55,545.03
PFAS Regenerable Resin Replacement (Every Other Year)	CF	$ 80.00	160	$ 12,800.00
Resin Removal and Disposal (Every Other Year)	LS	$ 7,950.00	1	$ 7,950.00
O&M, Sampling and Analysis (Monthly)	Events	$ 2,500.00	12	$ 30,000.00
			Cost per Year (Years 1 & 2)	$ 238,542.03
			Cost per Year (Year 3 - 30)	$ 225,742.03
			Total Cost (30 Years)	$ 10,467,676.70

Location:	Former NAS Brunswick Brunswick, Maine				
Project:	Engineering Evaluation/Cost Analysis for PFAS in Groundwater Table A-10: GAC GWTS Net Present Worth				
YEAR	**CAPITAL COST**	**OPERATION AND MAINTENANCE COST**	**TOTAL YEARLY COST**	**PRESENT-WORTH FACTOR**	**PRESENT WORTH**
				0.50%	
0	$ 3,229,340.03		$ 3,229,340.03	1.000	$ 3,229,340.03
1		$ 340,592.03	$ 340,592.03	0.995	$ 338,897.54
2		$ 340,592.03	$ 340,592.03	0.990	$ 337,211.48
3		$ 318,592.03	$ 318,592.03	0.985	$ 313,860.54
4		$ 318,592.03	$ 318,592.03	0.980	$ 312,299.05
5		$ 318,592.03	$ 318,592.03	0.975	$ 310,745.32
6		$ 318,592.03	$ 318,592.03	0.971	$ 309,199.32
7		$ 318,592.03	$ 318,592.03	0.966	$ 307,661.02
8		$ 318,592.03	$ 318,592.03	0.961	$ 306,130.37
9		$ 318,592.03	$ 318,592.03	0.956	$ 304,607.33
10		$ 318,592.03	$ 318,592.03	0.951	$ 303,091.87
11		$ 318,592.03	$ 318,592.03	0.947	$ 301,583.95
12		$ 318,592.03	$ 318,592.03	0.942	$ 300,083.53
13		$ 318,592.03	$ 318,592.03	0.937	$ 298,590.58
14		$ 318,592.03	$ 318,592.03	0.933	$ 297,105.06
15		$ 318,592.03	$ 318,592.03	0.928	$ 295,626.92
16		$ 318,592.03	$ 318,592.03	0.923	$ 294,156.14
17		$ 318,592.03	$ 318,592.03	0.919	$ 292,692.68
18		$ 318,592.03	$ 318,592.03	0.914	$ 291,236.49
19		$ 318,592.03	$ 318,592.03	0.910	$ 289,787.56
20		$ 318,592.03	$ 318,592.03	0.905	$ 288,345.83
21		$ 318,592.03	$ 318,592.03	0.901	$ 286,911.27
22		$ 318,592.03	$ 318,592.03	0.896	$ 285,483.85
23		$ 318,592.03	$ 318,592.03	0.892	$ 284,063.53
24		$ 318,592.03	$ 318,592.03	0.887	$ 282,650.28
25		$ 318,592.03	$ 318,592.03	0.883	$ 281,244.06
26		$ 318,592.03	$ 318,592.03	0.878	$ 279,844.84
27		$ 318,592.03	$ 318,592.03	0.874	$ 278,452.58
28		$ 318,592.03	$ 318,592.03	0.870	$ 277,067.24
29		$ 318,592.03	$ 318,592.03	0.865	$ 275,688.80
30		$ 318,592.03	$ 318,592.03	0.861	$ 274,317.21
				TOTAL PRESENT WORTH	**$ 12,127,976.29**

Note:
Real Discount Rate of 0.5% for 30-Year per OMB Circular No. A-94, March 2022.

Location:	Former NAS Brunswick Brunswick, Maine				
Project:	Engineering Evaluation/Cost Analysis for PFAS in Groundwater Table A-11: Ion Exchange GWTS Net Present Worth				
YEAR	**CAPITAL COST**	**OPERATION AND MAINTENANCE COST**	**TOTAL YEARLY COST**	**PRESENT-WORTH FACTOR**	**PRESENT WORTH**
				0.50%	
0	$ 2,977,074.86		$ 2,977,074.86	1.000	$ 2,977,074.86
1		$ 115,742.03	$ 115,742.03	0.995	$ 115,166.20
2		$ 115,742.03	$ 115,742.03	0.990	$ 114,593.23
3		$ 93,742.03	$ 93,742.03	0.985	$ 92,349.84
4		$ 93,742.03	$ 93,742.03	0.980	$ 91,890.39
5		$ 93,742.03	$ 93,742.03	0.975	$ 91,433.23
6		$ 93,742.03	$ 93,742.03	0.971	$ 90,978.33
7		$ 93,742.03	$ 93,742.03	0.966	$ 90,525.71
8		$ 93,742.03	$ 93,742.03	0.961	$ 90,075.33
9		$ 93,742.03	$ 93,742.03	0.956	$ 89,627.19
10		$ 93,742.03	$ 93,742.03	0.951	$ 89,181.29
11		$ 93,742.03	$ 93,742.03	0.947	$ 88,737.60
12		$ 93,742.03	$ 93,742.03	0.942	$ 88,296.12
13		$ 93,742.03	$ 93,742.03	0.937	$ 87,856.83
14		$ 93,742.03	$ 93,742.03	0.933	$ 87,419.74
15		$ 93,742.03	$ 93,742.03	0.928	$ 86,984.81
16		$ 93,742.03	$ 93,742.03	0.923	$ 86,552.05
17		$ 93,742.03	$ 93,742.03	0.919	$ 86,121.44
18		$ 93,742.03	$ 93,742.03	0.914	$ 85,692.98
19		$ 93,742.03	$ 93,742.03	0.910	$ 85,266.65
20		$ 93,742.03	$ 93,742.03	0.905	$ 84,842.43
21		$ 93,742.03	$ 93,742.03	0.901	$ 84,420.33
22		$ 93,742.03	$ 93,742.03	0.896	$ 84,000.33
23		$ 93,742.03	$ 93,742.03	0.892	$ 83,582.42
24		$ 93,742.03	$ 93,742.03	0.887	$ 83,166.59
25		$ 93,742.03	$ 93,742.03	0.883	$ 82,752.82
26		$ 93,742.03	$ 93,742.03	0.878	$ 82,341.12
27		$ 93,742.03	$ 93,742.03	0.874	$ 81,931.46
28		$ 93,742.03	$ 93,742.03	0.870	$ 81,523.84
29		$ 93,742.03	$ 93,742.03	0.865	$ 81,118.25
30		$ 93,742.03	$ 93,742.03	0.861	$ 80,714.67
				TOTAL PRESENT WORTH	**$ 5,626,218.08**

Note:
Real Discount Rate of 0.5% for 30-Year per OMB Circular No. A-94, March 2022.

Location:	Former NAS Brunswick Brunswick, Maine				
Project:	Engineering Evaluation/Cost Analysis for PFAS in Groundwater Table A-12: GAC & Ion Exchange GWTS Net Present Worth				
YEAR	**CAPITAL COST**	**OPERATION AND MAINTENANCE COST**	**TOTAL YEARLY COST**	**PRESENT-WORTH FACTOR**	**PRESENT WORTH**
				0.50%	
0	$ 4,167,981.26		$ 4,167,981.26	1.000	$ 4,167,981.26
1		$ 238,542.03	$ 238,542.03	0.995	$ 237,355.25
2		$ 238,542.03	$ 238,542.03	0.990	$ 236,174.38
3		$ 225,742.03	$ 225,742.03	0.985	$ 222,389.48
4		$ 225,742.03	$ 225,742.03	0.980	$ 221,283.07
5		$ 225,742.03	$ 225,742.03	0.975	$ 220,182.15
6		$ 225,742.03	$ 225,742.03	0.971	$ 219,086.72
7		$ 225,742.03	$ 225,742.03	0.966	$ 217,996.74
8		$ 225,742.03	$ 225,742.03	0.961	$ 216,912.18
9		$ 225,742.03	$ 225,742.03	0.956	$ 215,833.01
10		$ 225,742.03	$ 225,742.03	0.951	$ 214,759.22
11		$ 225,742.03	$ 225,742.03	0.947	$ 213,690.76
12		$ 225,742.03	$ 225,742.03	0.942	$ 212,627.62
13		$ 225,742.03	$ 225,742.03	0.937	$ 211,569.77
14		$ 225,742.03	$ 225,742.03	0.933	$ 210,517.19
15		$ 225,742.03	$ 225,742.03	0.928	$ 209,469.84
16		$ 225,742.03	$ 225,742.03	0.923	$ 208,427.70
17		$ 225,742.03	$ 225,742.03	0.919	$ 207,390.75
18		$ 225,742.03	$ 225,742.03	0.914	$ 206,358.95
19		$ 225,742.03	$ 225,742.03	0.910	$ 205,332.29
20		$ 225,742.03	$ 225,742.03	0.905	$ 204,310.74
21		$ 225,742.03	$ 225,742.03	0.901	$ 203,294.27
22		$ 225,742.03	$ 225,742.03	0.896	$ 202,282.85
23		$ 225,742.03	$ 225,742.03	0.892	$ 201,276.47
24		$ 225,742.03	$ 225,742.03	0.887	$ 200,275.09
25		$ 225,742.03	$ 225,742.03	0.883	$ 199,278.70
26		$ 225,742.03	$ 225,742.03	0.878	$ 198,287.26
27		$ 225,742.03	$ 225,742.03	0.874	$ 197,300.76
28		$ 225,742.03	$ 225,742.03	0.870	$ 196,319.16
29		$ 225,742.03	$ 225,742.03	0.865	$ 195,342.45
30		$ 225,742.03	$ 225,742.03	0.861	$ 194,370.60
				TOTAL PRESENT WORTH	**$ 10,467,676.70**

Note:
Real Discount Rate of 0.5% for 30-Year per OMB Circular No. A-94, March 2022.

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