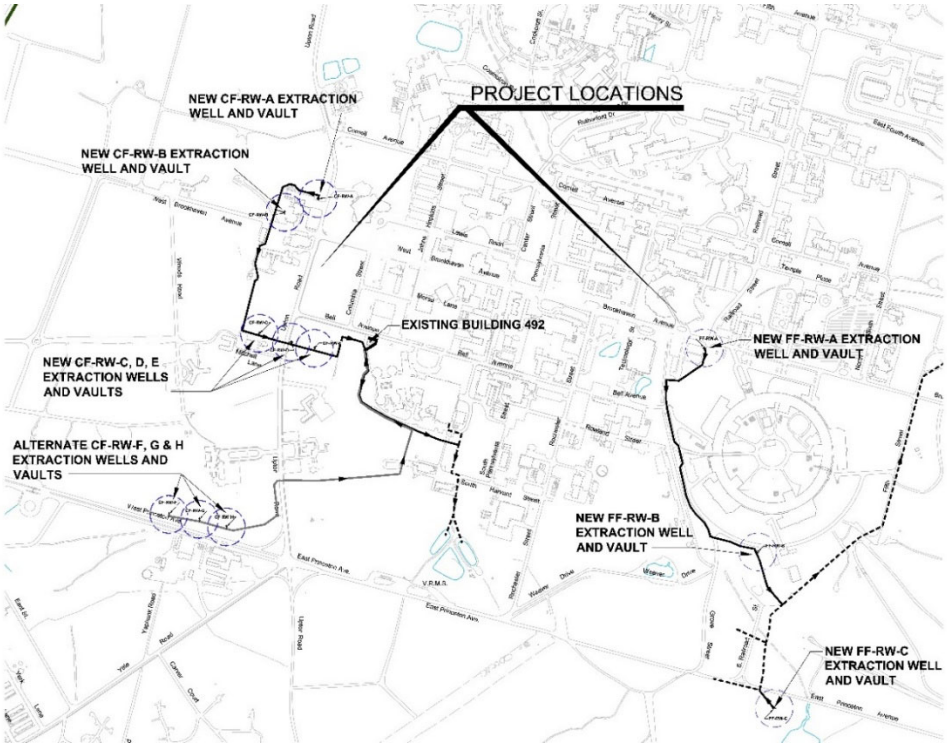
BROOKHAVEN
NATIONAL LABORATORY

Action Memorandum for PFAS Source Area Groundwater Treatment Systems



June 1, 2021

PREPARED FOR:
The United States Department of Energy Office of Science

PREPARED BY:
Environmental Protection Division
Brookhaven National Laboratory
Upton, New York 11973

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Concurrence Page

Title: *Action Memorandum for the PFAS Source Area Groundwater Treatment Systems*

U.S. Environmental Protection Agency	Signature	Date

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Acronyms

AM	action memorandum
AOC	area of concern
ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
CERCLA	*Comprehensive Environmental Response, Compensation and Liability Act of 1980*
DOE	U.S. Department of Energy
FFA	federal facilities agreement
MCL	maximum contaminant level
NCP	National Contingency Plan
O&M	operations and maintenance
OU	operable unit
PFAS	per- and polyfluoroalkyl substances
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
RI/FS	remedial investigation/feasibility study
ROD	record of decision
SPDES	state pollutant discharge elimination system
TCRA	time critical removal action

I. Purpose

The purpose of this action memorandum (AM) is to document the decision by the U.S. Department of Energy (DOE) to conduct a time-critical removal action (TCRA) and install two groundwater treatment systems to address Per- and Polyfluoroalkyl Substances (PFAS) contamination from two source areas on the Brookhaven National Laboratory (BNL) site. This action is being undertaken as a TCRA in accordance with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the BNL Federal Facilities Agreement (FFA) among DOE, the U.S. Environmental Protection Agency (EPA) and the New York State Department of Environmental Conservation (NYSDEC). Work will be conducted in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP, 40 CFR 300).

II. Site Information

1.0 Facility Description and Background

Brookhaven National Laboratory is located in Upton, Suffolk County, New York, near the geographic center of Long Island. The site encompasses approximately 5,300 acres, 75 percent of which is wooded. The remainder is developed and contains office buildings, various large research facilities, and parking lots. The BNL site, formerly occupied by the U.S. Army as Camp Upton during World Wars I and II, was transferred to the Atomic Energy Commission in 1947, to the Energy Research and Development Administration in 1975, and to the Department of Energy in 1977. It has been used as a National Laboratory since 1947. The BNL site is owned by the DOE and is operated by Brookhaven Science Associates (BSA). BSA carries out basic and applied research in high-energy nuclear physics and solid-state physics; fundamental material and structure properties and the interaction of matter; biomedical and environmental sciences; as well as in energy technologies and national security.

In 1980, the BNL site was placed on the NYSDEC list of Inactive Hazardous Waste Disposal Sites. In 1989, BNL was also included on the EPA National Priorities List because of soil and groundwater contamination. Subsequently, DOE, EPA and NYSDEC entered into a FFA (also referred to as the Interagency Agreement, or IAG). While not formal IAG partners, the Suffolk County Department of Health Services (SCDHS) and the New York State Department of Health (NYSDOH) are also actively involved with BNL cleanup decisions. The FFA became effective in 1992, and it identified areas of concern (AOCs) that were grouped into operable units (OUs) to be evaluated for response actions. The FFA established the framework and schedule for characterizing, assessing, and remediating the site in accordance with the requirements of CERCLA. There are 34 AOCs and eight OUs at the BNL site. DOE recommended the addition of AOCs 33 (perfluorooctane sulfonate or PFOS and perfluorooctanoic acid or PFOA) and 34 (1,4-dioxane) under Operable Unit (OU) VIII to the regulators in February 2021.

2.0 Removal Site Evaluation

Following the 2017 detection of PFAS in three BNL potable water supply wells, a comprehensive search of available records, documents and interviews with long-term current and former employees identified eight areas where firefighting foam had been released to the ground during the period of 1966 through 2008. BSA also analyzed Sewage Treatment Plant (STP) influent and effluent and STP groundwater monitoring wells to evaluate potential impacts from current discharges of PFAS-contaminated water from the impacted supply wells. Characterization efforts have confirmed that groundwater at nine areas (Sub-AOCs 33a through 33i) has been impacted by PFAS that were in firefighting foams used at BNL until 2008. PFOS and PFOA concentrations were found to exceed New York State's 10 ng/L maximum contaminant level (MCL) at all nine of the Sub-AOCs. Results from the characterization of groundwater in eight foam release areas were presented in the *2018 BNL Groundwater Status Report* (BNL 2019). From 2019 through early 2021, BNL conducted a comprehensive sampling of on-site and off-site monitoring wells, groundwater treatment systems, as well as detailed characterizations of the PFAS plumes associated with the Current Firehouse and Former Firehouse historical foam training areas. These characterization efforts did not identify any additional PFAS source areas. Results from PFAS characterization efforts performed during 2020 and early 2021 are presented in the *Phase 4*

Characterization Report, Per- and Polyfluoroalkyl Substances (PFAS) and 1,4-Dioxane in On-Site and Off-Site Monitoring Wells, Extraction Wells and Treatment Systems (BNL 2021a) and *Time Critical Removal Action for Per- and Polyfluoroalkyl Substances (PFAS) in Groundwater Downgradient of the Current and Former Firehouse Facilities Plume Characterization Report Characterization Report* (BNL 2021b).

In February 2021, DOE submitted to the regulators a justification for including PFOS, PFOA and 1,4-dioxane as new AOCs under a new operable unit (OU VIII), *Justification for Proposed PFOS/PFOA and 1,4-Dioxane Areas of Concern,* (2021c). Following regulatory comments, a revised *Justification* was submitted to the regulators on May 4, 2021.

The TCRA covered by this Action Memorandum is intended to address groundwater contaminated with PFAS that is migrating downgradient of the Current and Former Firehouse areas. Two groundwater treatment systems will be installed to hydraulically capture and treat the high concentration plume segments associated with these two source areas. The contaminated water, withdrawn from the aquifer via a series of extraction wells, will be treated using granular activated carbon. The treated water will be discharged into two existing recharge basins. A network of monitoring wells will be installed to monitor the performance of the treatment system and track remediation of the plumes over time.

3.0 Physical Location and Site Characteristics

The Current Firehouse (Building 599) is located in the western portion of the BNL site and has been in continuous use since 1986 (**Figure 1**). Firefighters trained with Class B foam in the paved area along the north side of the firehouse, and in the adjacent grass and wooded areas to the north (**Figure 2**). Based upon PFAS concentrations in groundwater, it appears that most training with foam occurred in the eastern portion of the training area. A fire extinguisher training area was located to the northwest of the firehouse, and it is believed that foam had been used in this area as well. Foam released to the paved areas along the north side of the firehouse is known to have entered at least one of the drywells that are used for stormwater management. Furthermore, as part of routine maintenance of firetruck foam systems, foam may have been released to the floor drain system in the firehouse high bay area. The floor drains are connected to BNL's sanitary system. The last known training event where Class B foam was used occurred in 2008.

The Former Firehouse (former Building 99) was located in the central portion of the BNL site and operated from 1947 through 1985 (**Figure 1**). Available records indicate that firefighting foam was used for training as early as 1966. Firefighters practiced with foam primarily in a training area that was located immediately west of the firehouse (**Figure 3**). A second training area was located east of the firehouse, where firefighters would periodically practice extinguishing car fires using foam. There are no available records on foam formulations or on the amount used at the former firehouse. Most of the training area that was located to the west of the firehouse is presently occupied by Building 725 (currently used by the Computational Science Initiative), which was constructed in the early 1980s. The Former Firehouse structure was demolished in March 1986. Following demolition, low level radiologically contaminated soils were excavated from this area. These actions were documented in the OU III ROD (AOC 22). It is unknown whether excavation activities during the construction of Building 725 resulted in the removal of PFAS contaminated soil from the area. Available records indicate that the Former Firehouse did not have floor drains. Exterior storm drains may have discharged to a drainage culvert located several hundred feet to the southwest of the firehouse.

4.0 Release or Threatened Release into the Environment of a Hazardous Substance, Pollutant, or Contaminant

As noted in Section 3.0 above, firefighting foam was used for training purposes at BNL's Current Firehouse between 1986 and 2008, and at the Former Firehouse between 1966 and 1985. Some of the foam used for training contained PFAS, which can persist in soils and groundwater for long periods of time.

Since characterization of the groundwater for PFAS at BNL began in 2018, elevated PFOS and PFOA concentrations were detected in temporary wells and permanent monitoring wells at and downgradient of the Current and Former Firehouses. The concentrations exceeded EPA's lifetime health advisory level (HAL) of 70 ng/L for combined PFOS and PFOA. In August 2020, NYS promulgated drinking water standards of 10 ng/L for PFOS and 10 ng/L for PFOA. PFOS and PFOA have been detected in the groundwater downgradient of the Current Firehouse at concentrations up to 12,200 ng/L and 602 ng/L, respectively. PFOS and PFOA concentrations greater than 10 ng/L were identified from the Current Firehouse area approximately 2,900 feet south to West Princeton Avenue. PFOS and PFOA have been detected in in the groundwater downgradient of the Former Firehouse at concentrations up to 5,210 ng/L and 1,400 ng/L, respectively. PFOS and PFOA at concentrations greater than 10 ng/L have been traced from the Former Firehouse facility approximately 3,000 feet south to the East Princeton Avenue area. The aquifers on Long Island have been designated as a "sole-source aquifer system" by the EPA and serves as the primary source of drinking water.

5.0 National Priorities List Status

In 1989, BNL was included on the EPA National Priorities List because of soil and groundwater contamination. Subsequently, DOE, EPA and NYSDEC entered into a FFA (also referred to as the Interagency Agreement, or IAG). In February 2021, DOE recommended the addition of AOCs 33 (PFOS and PFOA) and 34 (1,4-dioxane) and OU VIII to the regulators for characterizing, assessing, and remediating the site in accordance with the requirements of CERCLA. As a result, there are now 34 AOCs and eight OUs at the BNL site.

6.0 Maps, Pictures, and Other Graphic Representations

Several figures are included in the Action Memorandum that provide graphical representations of the PFAS emanating from the Current and Former Firehouses and the planned removal action. These include:

Figure 1 – Current and Former Firehouse Location
Figure 2 – Current Firehouse PFAS Plume
Figure 3 – Former Firehouse PFAS Plume
Figure 4 – Current Firehouse PFAS Planned Extraction Wells
Figure 5 – Former Firehouse PFAS Planned Extraction Wells
Figure 6 – Planned PFAS Treatment System Location and Layout for the Current and Former Firehouse Plumes

7.0 Other Actions to Date

There have been no previous cleanup actions performed under CERCLA associated with the PFAS plumes. Monitoring conducted since 2017 has demonstrated that PFAS contamination has impacted water quality in four of BNL's potable supply wells (BNL-6, BNL-10, BNL-11 and BNL-12). In 2019, BNL started work to return to service granular activated carbon filters to remove PFOS and PFOA at potable wells BNL-10, BNL-11, and BNL-12. Filters at wells BNL-11 and BNL-10 were back in service in late 2020 and May 2021, respectively. Potable well BNL-12 will be back in service in the fall of 2021. Furthermore, BNL has placed restrictions on the continued use of potable supply wells BNL-4 and BNL-6 due to their proximity to the Current Firehouse PFAS plume.

8.0 State and Local Authorities' Roles

Under Executive Order 12580, the President delegates authority to undertake CERCLA response actions to the Department of Energy (DOE). CERCLA Section 121 requires the DOE to apply certain state removal and remedial action law requirements at its sites. The DOE is the lead agency for this TCRA and as such will be responsible for funding and conducting the response. There have been no past New York State or local (Suffolk County) actions at this site and neither the State nor local agencies will be responsible for the response.

The DOE will continue to be the lead agency and the exclusive source of funding for removal and remedial actions associated with the BNL NPL site. As joint parties to the BNL FFA, EPA and NYSDEC have oversight of the planned removal action. While not formal FFA partners, the NYSDOH and SCDHS are also actively involved with BNL cleanup decisions.

III. Threats to Public Health, Welfare, or the Environment

1.0 Nature of Actual or Threatened Release of Hazardous Substances, Pollutants, or Contaminants

As a result of the documented releases of firefighting foam to the ground from 1966 through 2008, PFAS has migrated through the soil and into the groundwater, which is designated as a sole source of drinking water for Long Island. Based on groundwater samples collected to date, PFOS and PFOA have been detected significantly above the State MCL of 10 ng/L at and downgradient of the Current and Former Firehouse areas. The continued detection of high levels of these chemicals in the groundwater near the firehouse foam training areas indicate that significant levels of residual PFAS may be present in the source area soils. The last known training event where Class B foam was used at the Current Firehouse was in 2008. In 2019, BNL replaced the remaining inventory of Class B foam that contained fluorosurfactants with PFAS-free foam.

BNL has returned to service GAC filters at water supply wells BNL-10 and BNL-11 and plans to have the GAC filters at BNL-12 operational by the end of 2021. The PFAS released from the Current Firehouse area has impacted the operation of BNL potable supply wells BNL-4 and BNL-6. See discussion in Section 7.0 above for corrective actions being taken. In cooperation with SCDHS, private wells downgradient of BNL that are still being used as the homeowner's sole source of drinking water, were sampled for PFAS. There were no PFAS detections that were attributable to BNL operations.

2.0 Check Applicable Factors Considered in Determining the Appropriateness of a Removal Action

Title 40 of the Code of Federal Regulations (CFR) Part 300 is the NCP. Section 415 of the NCP lists the factors to be considered in determining the appropriateness of a TCRA. Paragraph (b)(2) of Section 415 describes the necessary conditions as follows:

X	Actual or potential exposure to nearby human populations, animals or the food chain from hazardous substances or pollutants or contaminants [40 CFR 300.415(b)(2)(i)].
X	Actual or potential contamination of drinking water supplies or sensitive ecosystems [40 CFR 300.415(b)(2)(ii)].
	Hazardous substances or pollutants or contaminants in drums, barrels, tanks, or other bulk storage containers, that pose a threat of release [40 CFR 300.415(b)(2)(iii)].
X	High levels of hazardous substances or pollutants or contaminants in soils largely at or near the surface that may migrate [40 CFR 300.415(b)(2)(iv)].
	Weather conditions that may cause hazardous substances or pollutants to migrate or to be released [40 CFR 300.415(b)(2)(v)].
	Threat of fire or explosion [300.415(b)(2)(vi)].
	The availability of other appropriate federal or state response mechanisms to respond to the release [40 CFR 300.415(b)(2)(vii)].
	Other situations or factors that may pose threats to the public health or welfare of the United States or the environment [40 CFR 300.415(b)(2)(viii)].

IV. Endangerment Determination

In January 2021, EPA requested comments on a proposed rulemaking to add PFOS and PFOS to the CERCLA list of hazardous substances. A final decision is pending. The NYSDEC, under 6 NYCRR Part 597, considers PFOS and PFOA hazardous substances.

Actual or threatened releases of hazardous substances from this site may present an imminent and substantial endangerment to public health, or welfare, or the environment. PFOS and PFOA have been detected significantly above the State MCL of 10 ng/L at and downgradient of the Current and Former Firehouse areas. This release, which if not addressed by implementing the TCRA discussed in this Action Memorandum will continue to migrate unabated and impact the sole source aquifer and the BNL potable water supply. Based on experience with several other groundwater cleanup remedies at BNL, the sooner a plume is contained downgradient of an identified source area, the more effective and efficient the remediation is over time.

V. Proposed Actions and Estimated Costs

1.0 Removal Action Description

Based on the characterization data obtained during 2020 and early 2021, the proposed action is to install two groundwater treatment systems to address PFAS contamination in the Upper Glacial aquifer that originates from the Current and Former Firehouse source areas. This includes:

1. Current Firehouse: Up to eight groundwater extraction wells will be installed to capture PFOS or PFOA concentrations of 100 ng/L or greater. See **Figure 4** for the planned extraction well locations. The three wells along Princeton Avenue are an alternate in the construction bid and may not be installed at this time depending upon the available funds to complete this work. The extracted groundwater will be treated via two new granular activated carbon vessels located at existing Building 492. The treated water will be discharged into the OU III recharge basin and the RA V recharge basin (**Figure 6**).

2. Former Firehouse: Three groundwater extraction wells will be installed to capture PFOS or PFOA concentrations of 100 ng/L or greater. See **Figure 5** for the planned extraction well locations. The extracted groundwater will be treated via two existing granular activated carbon vessels located adjacent to existing Building 598. The carbon filter vessels will be rehabilitated and will have a steel frame building erected to enclose them. The treated water will be discharged into the RA V recharge basin (**Figure 6**).

3. Discharge from the treatment systems will be monitored in accordance with a State Pollutant Discharge Elimination System (SPDES) Equivalency Permit(s) for the Current Firehouse and Former Firehouse Systems. BSA will submit an application to the NYSDEC for the Equivalency Permit no less than six months prior to system start-up testing.

4. Additional monitoring wells will be installed for both systems to enable monitoring of plume movement and reduction during the course of remediation. See **Figures 4 and 5** for the location of the existing and planned monitoring wells.

Existing recharge basins will be used for cost effectiveness and to avoid creating new discharge locations which may impact other existing groundwater plumes.

The treatment system capture goal of 100 ng/L or greater for PFOS or PFOA will allow for capture of the high concentration portions of the plumes. Monitored natural attenuation will be implemented to address PFOS and PFOA concentrations less than 100 ng/L. The capture goal was set at ten times the MCL which is consistent with most of the other OU III groundwater removal and remedial action goals.

Groundwater modeling was used to determine the appropriate locations and flow rates for the extraction wells. See Appendix B and C of the *PFAS Source Area Groundwater Remediation Project, Current Firehouse and Former Firehouse Areas,* dated May 2021 (BNL 2021) for the groundwater modeling results. The detection of 1,4-dioxane at concentrations above the NYS 1.0 µg/L MCL in the areas where the southernmost extraction wells will be installed has added complexity to the system design. Therefore, the location and pumping rates of the extraction wells were designed to minimize capture of the 1,4-dioxane while still capturing the high concentration portions of the PFAS plume. Conventional granular activated carbon filtration methods used for treating PFAS are ineffective for 1,4-dioxane. The flow rates for the eight extraction wells for the Current Firehouse system are projected to range from 30 to 60 gpm, with a total system capacity of 750 gpm. The three Former Firehouse plume extraction wells are planned to pump at rates of 50 to 100 gpm, with a total system capacity of 750 gpm.

The proposed treatment systems will prevent or minimize further plume migration and also capture the highest concentration areas of the plumes to remove significant PFAS mass as quickly as possible. The PFAS contaminated groundwater with the highest PFOS and PFOA concentrations in the source areas are sufficiently well defined to allow placement of extraction wells. Future Remedial Investigation (RI) characterization will be conducted to verify the extent and PFOS/PFOA concentrations at the leading edges of the plumes.

2.0 Contribution to Remedial Performance

Although a Record of Decision (ROD) for OU VIII has not yet been issued, this proposed TCRA will contribute to the efficient performance of any long-term remedial action with respect to the release of PFAS at the BNL site. This planned action will address the highest areas of PFOS and PFOA groundwater contamination at BNL. The PFAS and 1,4-dioxane characterization efforts performed to date will significantly reduce the scope of the remaining RI work. Therefore, the RI characterization work will focus on filling data gaps in the distribution of PFOS, PFOA and 1,4-dioxane contamination in on-site and off-site groundwater, and in the characterization of PFAS in source area soils.

It is expected that the RI characterization for PFAS and 1,4-dioxane will be performed concurrently so as not to delay issuance of the RI Report, Feasibility Study, and subsequent ROD. While a single ROD will address final remedial decisions for PFOS, PFOA and 1,4-dioxane, the actual implementation of the remedies, as needed, may require a phased approach over several years. This phased approach is consistent with the process used to implement the OU III ROD and depends on factors such as risk to receptors, implementability (including the availability of contractor support, equipment, and materials) and cost/funding. Implementation of the remedies will be determined in the Remedial Design and Remedial Action Work Plans.

3.0 Applicable or Relevant and Appropriate Requirements (ARARs)

The TCRA documented in this Action Memorandum will comply with applicable or relevant and appropriate requirements (ARARs) to the extent practical. The following are potential federal and New York State ARARs for the TCRA for PFAS plume from the two firehouse areas. ARARs are typically categorized as chemical-, location-, and action-specific.

<u>Chemical-Specific ARARS</u>:

- A major ARAR governing the BNL site is the classification of the groundwater at and down gradient of the site as a federal "sole source aquifer system" containing Class GA fresh groundwater as defined by New York State. As such, federal and state MCLs and New York State Class GA groundwater quality standards were compiled to establish cleanup goals. The more stringent of the ARARs were used to establish the cleanup goals. The New York State DWS were selected as the cleanup goals.
- In August 2020, New York State promulgated DWS for PFOS at 10 ng/L and PFOA at 10 ng/L. Although these standards were established for drinking water, it is assumed that the Class GA groundwater standards will be the same.

- The New York State DWS for 1,4-dioxane of 1.0 µg/L was also promulgated in 2020. It is assumed that the Class GA groundwater standard will be the same. Although one of the goals of the treatment systems is to not entrain 1,4-dioxane in the extraction wells, there is a potential that low levels just above the DWS may be captured. 1,4-Dioxane is not treated with activated carbon and it is not practicable to add additional treatment to the proposed removal action. The need for active remediation of 1,4-dioxane in OU VIII will be determined during the RI/FS.

Location-Specific ARARS:

- None.

Action-Specific ARARS:

- The removal action will comply with New York State chemical-specific and action-specific ARARs at the discharge point through engineering controls, monitoring and acquisition of appropriate SPDES Equivalency Permits.

4.0 Project Schedule

The TCRA is anticipated to begin in July 2021. The duration of the field effort portion of the TCRA is assumed to be at least eight months; however, the actual start date and duration may vary depending on multiple factors, including Covid-19 pandemic restrictions and guidelines, contractor availability, availability of remediation equipment, public input, weather, etc. The expected critical milestone periods for the removal action are:

- Contract Award – June 2021
- Begin Construction – July 2021
- TCRA Construction – approximately 9 months (April 2022)
- SPDES Equivalency Permit Application – Submitted to NYSDEC 6 months prior to start-up
- Readiness Review/Follow-up Actions – 1 month
- System Start-up Monitoring – 2 to 3 months
- Submit Systems Start-up Reports to Regulators – 3 months after completion of start-up monitoring (November 2022)

Completion of the pump and treat system construction will be followed by a two to three-month period of start-up testing and then the initiation of routine operation and maintenance (O&M). An O&M Manual for the system will be submitted to the regulators prior to routine operations. This action will be followed by the preparation of a Start-up Report that will document construction completion and results of system start-up testing.

5.0 Estimated Costs

The costs presented in the TCRA assumes the construction of two groundwater treatment systems. The estimated costs for the proposed removal action are as follows:

Construction Cost	$4,450,000
Construction Oversight Cost	$400,000
Contingency Cost (18% of const. cost)	$800,000
Total Removal Action Capital Cost	$5,600,000

The estimated O&M costs for the two treatment systems is approximately $600K per year.

VI. Expected Change in the Situation Should Action be Delayed or Not Taken

A delay in action or no action at these source areas may present an imminent and substantial endangerment to public health, or welfare, or the environment from contaminant migration into the sole source aquifer system and migration off-site.

VII. Outstanding Policy Issues

None.

VIII. Approval

This decision document represents the selected removal action for this site, developed in accordance with CERCLA as amended, and not inconsistent with the NCP. This decision is based, in part, on the administrative record for the site. Conditions at the site meet CERCLA § 104(cl(1){A) and the NCP section 300.415{b) criteria for a removal action and through this document, I am approving the proposed removal action. The total project cost of approximately $5,600,000 will be funded by DOE. The removal outlined in this Action Memorandum is necessary in order to affect a continued response action to reduce the impact to the sole source aquifer and the BNL potable water supply. Such actions cannot be otherwise provided at the locations described herein in a timely manner.

Robert P. Gordon, Manager	ROBERT GORDON Digitally signed by ROBERT GORDON Date: 2021.06.04 09:30:02 -04'00'	6/4/21
Robert P. Gordon, Manager **U.S. Department of Energy** **Office of Science** **Brookhaven Site Office**	**Signature**	**Date**

IX. References

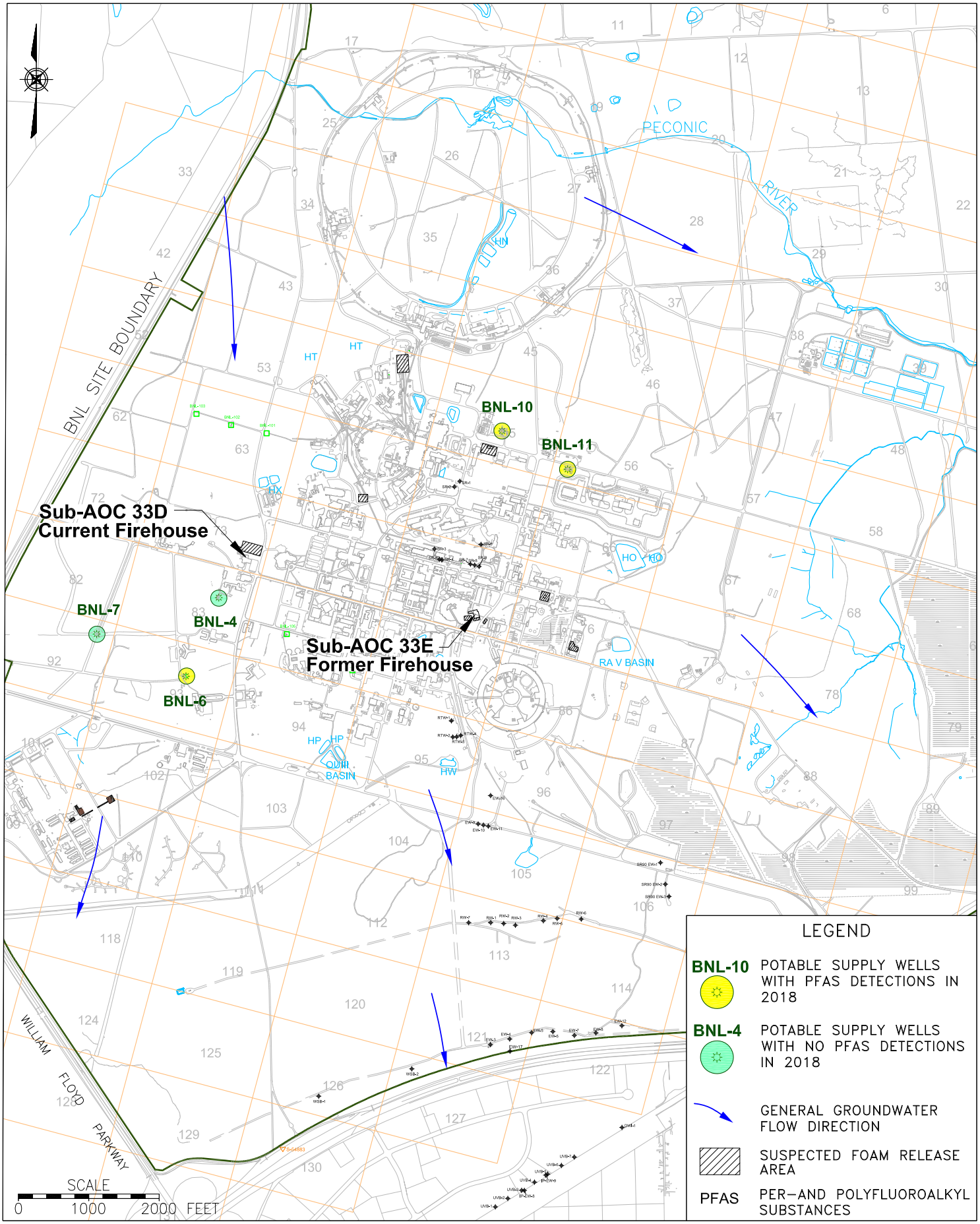
BNL, 2021a. *Phase 4 Characterization Report Per- and Polyfluoroalkyl Substances (PFAS) and 1,4-Dioxane in On-Site and Off-Site Monitoring Wells, Extraction Wells and Treatment Systems* – February 2021.

BNL 2021b. *Time Critical Removal Action for Per- and Polyfluoroalkyl Substances (PFAS) in Groundwater Downgradient of the Current and Former Firehouse Facilities Plume Characterization Report* – April 2021.

BNL 2021c. *Brookhaven National Laboratory Justification for Proposed PFOS/PFOA and 1,4-Dioxane Areas of Concern*, April 2021.

BNL, 2021d. *Design Report for PFAS Source Area Groundwater Treatment Systems Time Critical Removal Action* – May 2021.

Figures



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BROOKHAVEN NATIONAL LABORATORY

ENVIRONMENTAL PROTECTION DIVISION

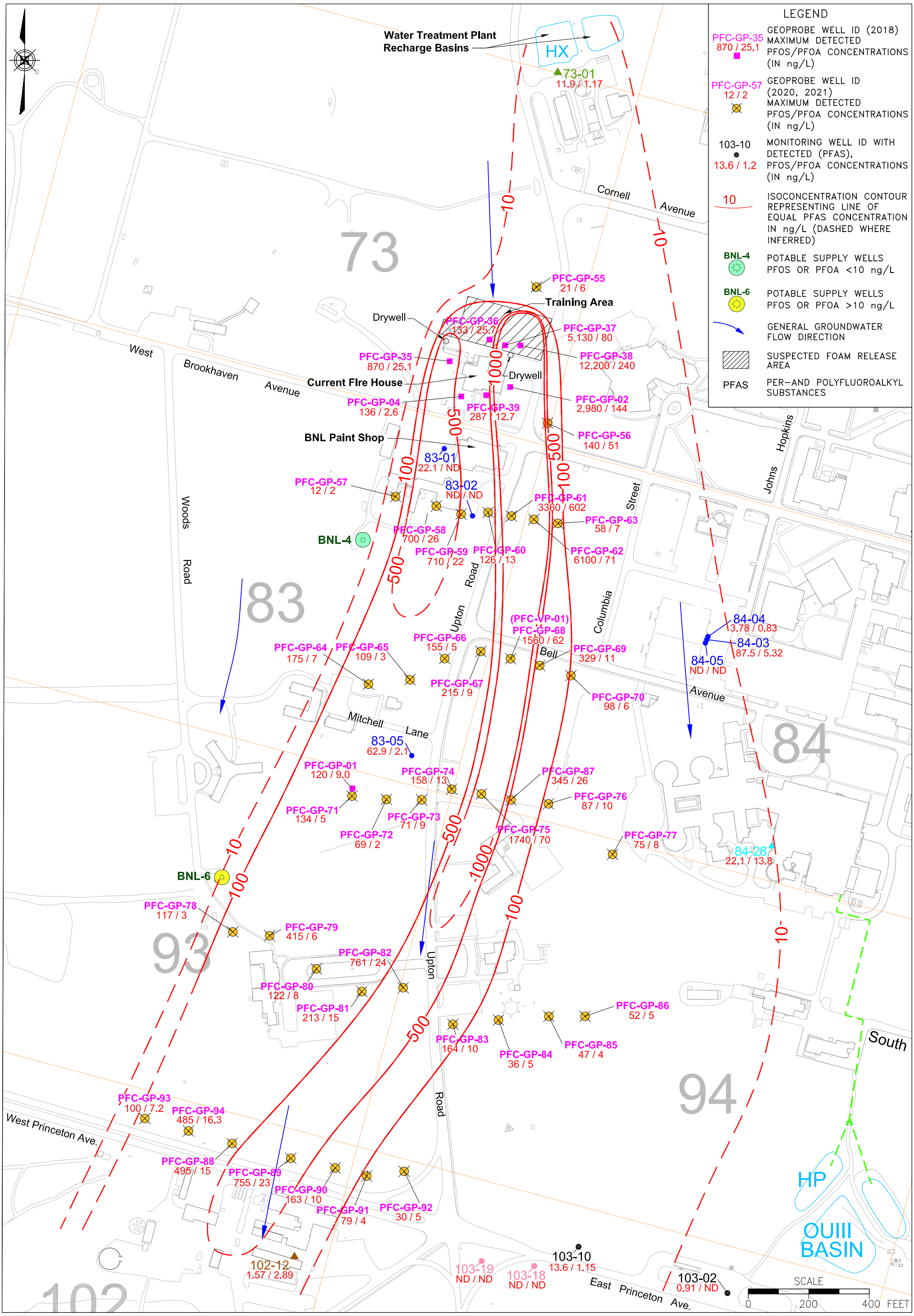
TITLE:

CURRENT AND FORMER FIREHOUSE LOCATIONS

TIME CRITICAL REMOVAL ACTION, ACTION MEMORANDUM

DWN:	VT:HZ.:	DATE:	PROJECT NO.:
AJZ	–	05/12/21	–
CHKD:	APPD:	REV.:	NOTES:
WRD	DEP		–

FIGURE NO.: 1



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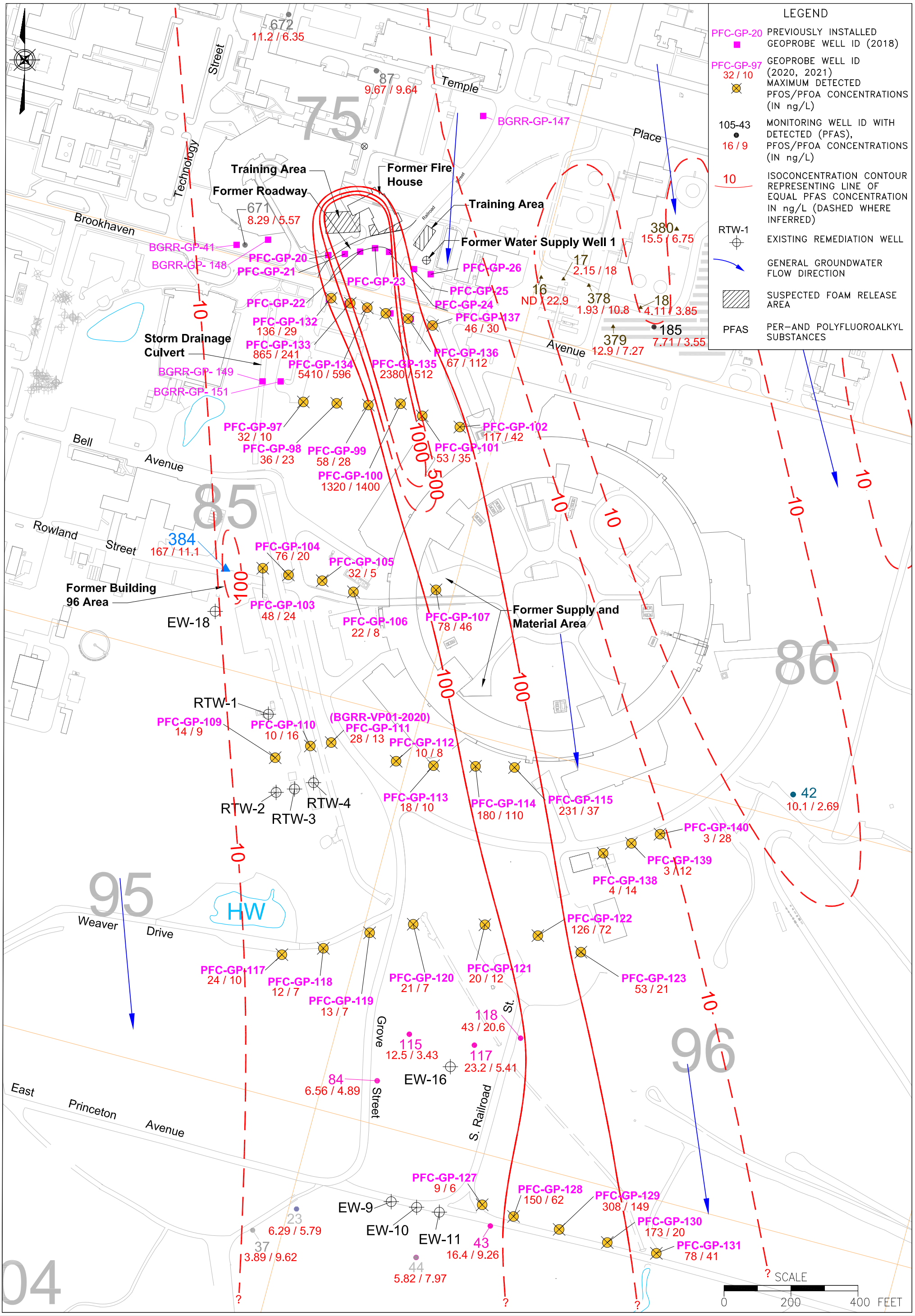
BROOKHAVEN NATIONAL LABORATORY ENVIRONMENTAL PROTECTION DIVISION	TITLE: CURRENT FIREHOUSE PFAS PLUME TIME CRITICAL REMOVAL ACTION, ACTION MEMORANDUM	DWN: AJZ	VT: HZ.: –	DATE: 06/17/20	PROJECT NO.: –
		CHKD: DEP	APPD: DEP	REV.: 05/12/21	NOTES: –
		FIGURE NO.: 2			



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BROOKHAVEN NATIONAL LABORATORY

ENVIRONMENTAL PROTECTION DIVISION

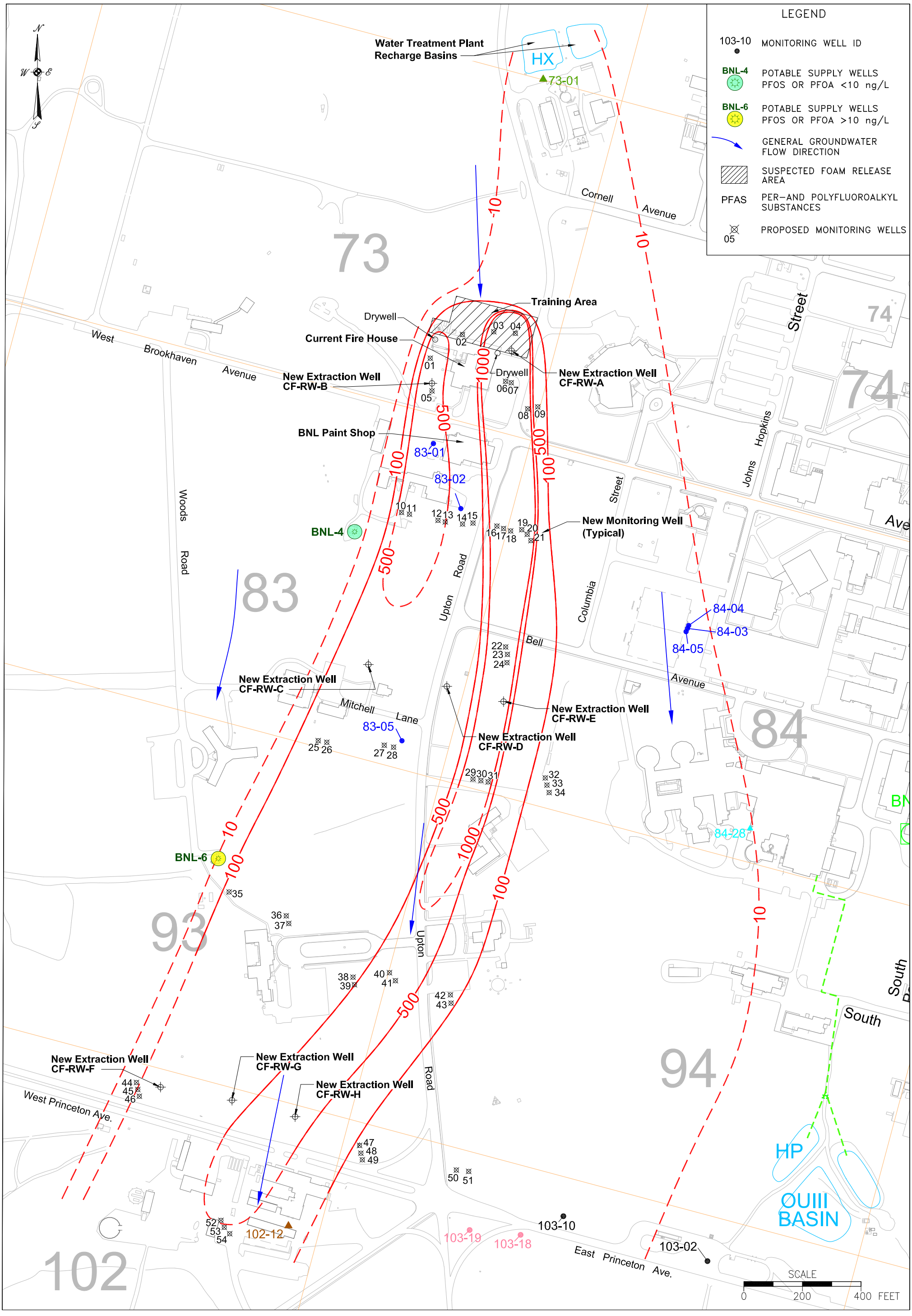
TITLE:

FORMER FIREHOUSE PFAS PLUME

TIME CRITICAL REMOVAL ACTION, ACTION MEMORANDUM

DWN:	VT: HZ.:	DATE:	PROJECT NO.:
AJZ	–	02/5/20	–
CHKD:	APPD:	REV.:	NOTES:
DEP	DEP	05/12/21	–

FIGURE NO.: 3



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BROOKHAVEN NATIONAL LABORATORY

ENVIRONMENTAL PROTECTION DIVISION

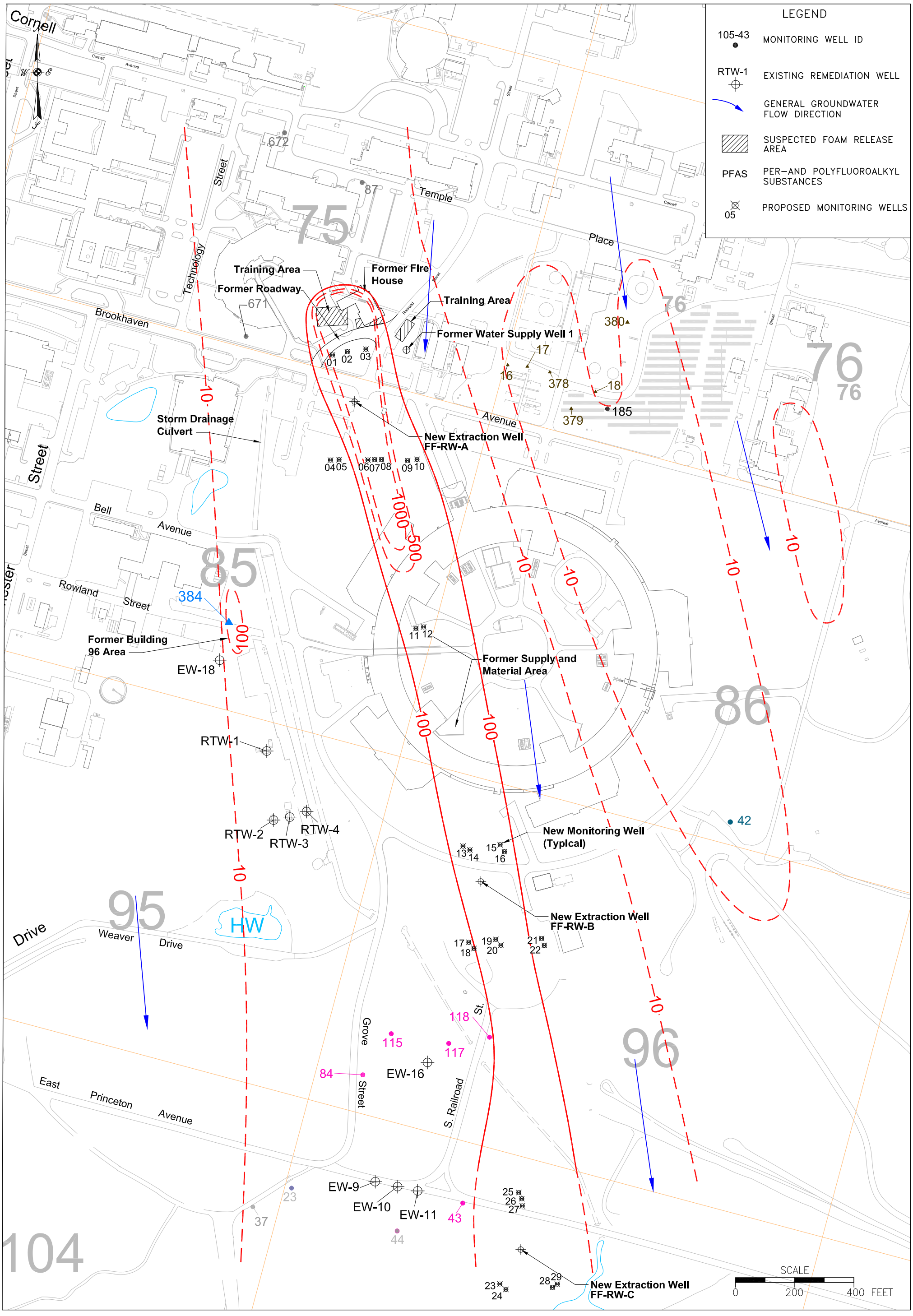
TITLE:

CURRENT FIREHOUSE PFAS PLANNED EXTRACTION WELLS

TIME CRITICAL REMOVAL ACTION, ACTION MEMORANDUM

DWN:	VT: HZ.:	DATE:	PROJECT NO.:
AJZ	–	02/5/20	–
CHKD:	APPD:	REV.:	NOTES:
DEP	DEP	05/28/21	–

FIGURE NO.: 4



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BROOKHAVEN NATIONAL LABORATORY

ENVIRONMENTAL PROTECTION DIVISION

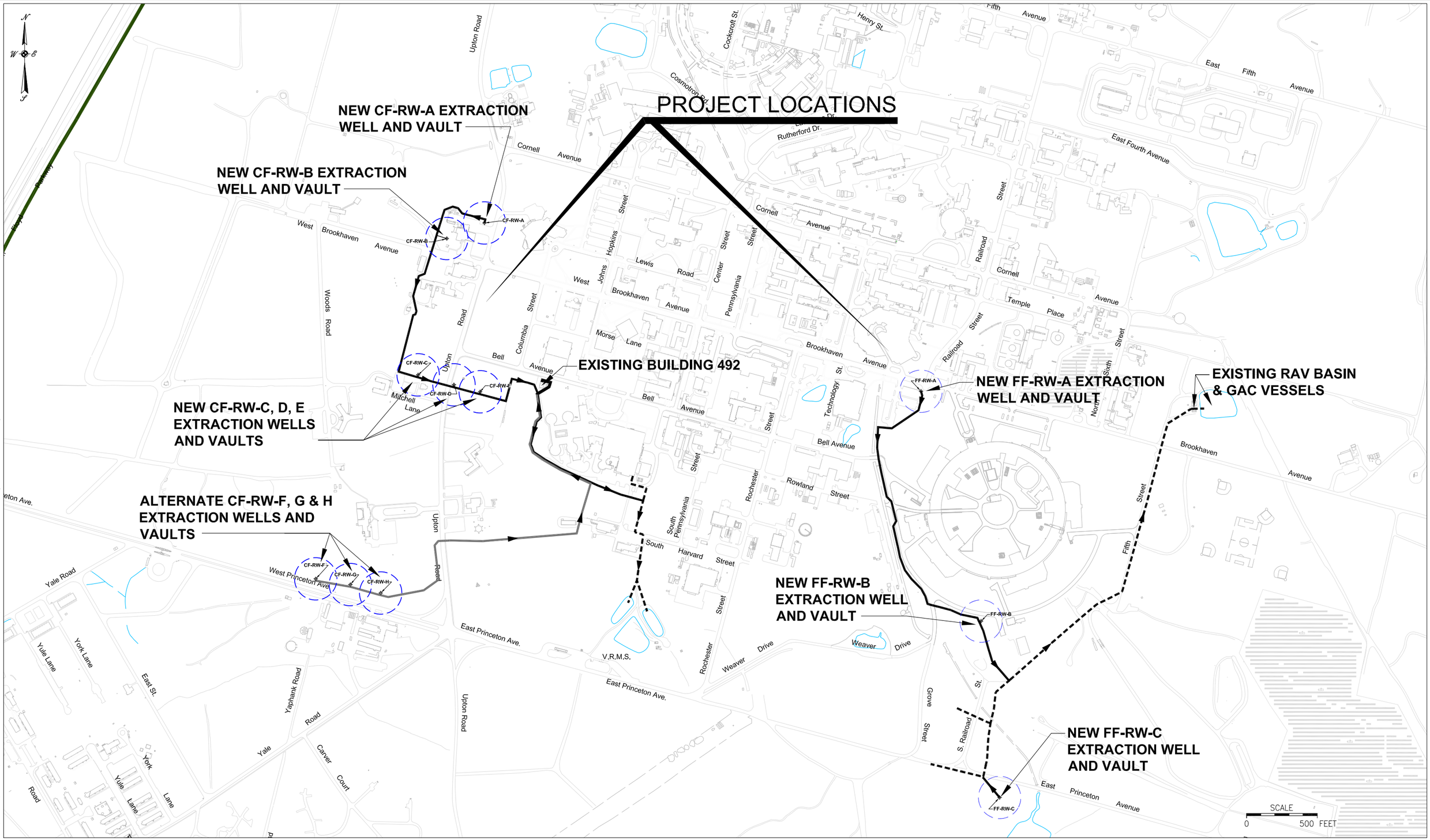
TITLE:

FORMER FIREHOUSE PFAS PLANNED EXTRACTION WELLS

TIME CRITICAL REMOVAL ACTION, ACTION MEMORANDUM

DWN:	VT: HZ.:	DATE:	PROJECT NO.:
AJZ	–	02/5/20	–
CHKD:	APPD:	REV.:	NOTES:
DEP	DEP	05/28/21	–

FIGURE NO.: 5



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BROOKHAVEN NATIONAL LABORATORY

ENVIRONMENTAL PROTECTION DIVISION

TITLE:

PLANNED PFAS TREATMENT SYSTEM LOCATION AND LAYOUT FOR THE CURRENT AND FORMER FIREHOUSE PLUMES

TIME CRITICAL REMOVAL ACTION, ACTION MEMORANDUM

DWN: AJZ	VT:HZ.: –	DATE: 03/30/21	PROJECT NO.: –
CHKD: WRD	APPD: WRD	REV.: 05/12/21	NOTES: –
FIGURE NO.: 6			