FINAL

Engineering Evaluation and Cost Analysis
Non-Time Critical Removal Action
Water Supply Well Decommissioning and Replacement
Joint Base McGuire-Dix-Lakehurst (JB MDL), New Jersey

Contract No. W9128F-18-D-0028

Delivery Order No. 0316

Prepared for:

U.S. Army Corps of Engineers
Omaha District
1616 Capitol Ave
Omaha, NE 68102-4901

Prepared by:

500 Pinnacle Court, Suite 100
Norcross, GA 30071

November 2019

Executive Summary

The United States Air Force (USAF) will conduct a non-time critical removal action (NTCRA) to address per- and polyfluorinated alkyl substances (PFAS) contamination in the drinking water at Joint Base McGuire-Dix-Lakehurst (JB MDL), New Jersey; specifically, this NTCRA will reduce or eliminate PFAS contamination obtained from two shallow supply wells in the JB MDL-Lakehurst Hill potable water system (PWS: NJ1511010). This NTCRA will be performed in accordance with, and satisfies the requirements of, the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), Title 42 United States Code (U.S.C.) §9604, as further implemented by the National Contingency Plan (NCP), Title 40 Code of Federal Regulations (CFR) §300.415. The USAF Installation Restoration Program (IRP) is authorized by the Defense Environmental Restoration Program (DERP) (10 U.S.C. 2701 et. seq.). The DERP is the environmental restoration program the military services use to conduct CERCLA response actions and satisfy CERCLA lead agency functions as delegated by Executive Order 12580. This engineering evaluation and cost analysis (EE/CA) has been prepared by CAPE Environmental Management Incorporated (CAPE), on behalf of the USAF, under U.S. Army Corps of Engineers (USACE), Omaha District, contract W9128F-18-D-0028.

PFAS are a class of synthetic fluorinated chemicals used in industrial and consumer products, including defense-related applications. In 1970, the Air Force began using aqueous film-forming foam (AFFF), firefighting agents containing PFAS, to extinguish petroleum fires. AFFF may contain perfluorooctane sulfonate (PFOS), and some PFAS-based AFFF constituents may further transform into perfluorooctanoate (PFOA). Releases of AFFF to the environment have occurred during fire training, equipment maintenance, storage, and use. Although the United States Environmental Protection Agency's (EPA) Office of Water (OW) has classified PFOS and PFOA as contaminants of emerging concern, there are currently no federal Safe Drinking Water Act (SDWA) maximum contaminant levels (MCLs) or promulgated cleanup levels regarding exposure levels. In 2016, the EPA established lifetime health advisory (HA) values for PFOS and PFOA in drinking water of 0.07 micrograms per liter (µg/L) (individually and combined) that the USAF is using as benchmarks to determine if response actions are needed.

The USAF sampled all water supply wells at JB MDL, except the Dix Main water system, in the Fall of 2016 under a USAF enterprise-wide task for PFAS, including PFOS/ PFOA. The Dix Main water system was sampled for PFAS under EPA's Third Unregulated Contaminant Monitoring Rule (UCMR3) in 2015 because this system serves more than 10,000 people. In summary, all of the results of the supply wells on JB MDL-McGuire and JB MDL-Dix, and of the JB MDL-Lakehurst Hill deep well, were below laboratory detection limits. PFAS were detected in several of the shallow backup supply wells that are part of the JB MDL-Lakehurst Hill PWS at concentrations below the EPA Lifetime HA for PFOS and PFOA. Subsequent resampling of Lakehurst Hill backup wells 5 and 9A in December 2016 revealed exceedances of the EPA lifetime HA. These shallow supply wells currently operate as back-up wells as part of the JB MDL-Lakehurst Hill PWS (NJ1511010). For security reasons, the exact locations of the wells are not shown in this EE/CA. An ion-exchange resin treatment system was installed between February and March 2019 as a temporary treatment measure. The New Jersey Department of Environmental Protection (NJDEP) Bureau of Water Systems Engineering issued a Temporary Treatment Approval (WTA180001) on 20 February 2019 to treat PFOS and PFOA from wells 5 and 9A using ion exchange. The temporary treatment approval expires on 28 February 2020. If the system is to operate beyond the expiration date, a Treatment Work Approval will be required to be obtained from NJDEP. Pursuant to the Temporary Treatment Approval requirements, the Treatment Works Approval shall be obtained prior to expiration of the Temporary Treatment Work Approval to continue to distribute drinking water from the

PWS; the PWS shall meet the requirements of the NJDEP Safe Drinking Water Act Rules (New Jersey Administrative Code [NJAC] 7:10-11).

This EE/CA identifies and evaluates proposed alternatives for completing the NTCRA. The EE/CA identifies removal action objectives (RAOs); identifies and evaluates potential alternatives for conducting the removal action; and recommends the best-suited removal action alternative. This removal action will provide a permanent solution to protect human health from exposure to PFOS and PFOA above the EPA lifetime HA in drinking water.

The RAO of the NTCRA is to eliminate the imminent and substantial danger to human health posed by PFOS/PFOA-contaminated drinking water from the JB MDL-Lakehurst Hill PWS wells 5 and 9A.

The following alternatives for achieving the RAO were evaluated:

- Alternative 1 - No action. With this alternative, no action would be taken to address PFOS/PFOA contamination in back-up wells 5 and 9A, which would leave the base with no back-up capability should the existing main deep well become inoperable. This alternative was evaluated to provide a baseline against which to compare the other alternatives.
- Alternative 2 - Maintain a recently installed ion-exchange resin treatment system as a long-term solution for wells 5 and 9A.
- Alternative 3 -Install a replacement deep well and treatment building, decommission wells 5 and 9A, and demolish the existing treatment building.

The three removal action alternatives were evaluated with respect to effectiveness, implementability, and cost. Alternative 1, no action, is included to provide a baseline against which to compare the other alternatives, has the lowest degree of effectiveness and implementability. Alternative 2 would require: ongoing operation and maintenance (O&M) of the mitigation system equipment; long-term monitoring for PFOS/PFOA; and estimated annual resin change-outs and disposal based on system design criteria. Alternative 3 would permanently eliminate the use of the PFOS/PFOA contaminated shallow drinking water source by installing a deep confined aquifer well and treatment building. Alternative 3 has a higher capital cost than Alternative 2 but would not have long-term O&M, related to PFOS/PFOA mitigation, beyond the normal operation of any drinking water system. The overall cost for Alternative 3 is less than Alternative 2. Based on its long-term effectiveness, the lack of long-term O&M of the mitigation system, eliminating PFOS/PFOA monitoring, eliminating spent resin change-outs and disposal, and the lower overall cost, Alternative 3 is the recommended removal action alternative.

Table of Contents

Table of Contents

Tables

Figures

Appendices

List of Acronyms

µg/L	micrograms per liter
AFB	Air Force Base
AFFF	Aqueous Film Forming Foam
AM	Action Memorandum
AOC	Area of Concern
ARAR	applicable or relevant and appropriate requirements
bgs	below ground surface
CAPE	CAPE Environmental Management Incorporated
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
DERP	Defense Environmental Restoration Program
DoDI	Department of Defense Instruction
DoDM	Department of Defense Manual
EE/CA	Engineering Evaluation and Cost Analysis
EO	Executive Order
EPA	United States Environmental Protection Agency
ESI	Expanded Site Investigation
ft	foot/feet
GAC	granular activated carbon
HA	Health Advisory
IRP	Installation Restoration Program
JB MDL	Joint Base McGuire, Dix, Lakehurst
MCL	maximum contaminant level
NAES	Naval Air Engineering Station
NCP	National Contingency Plan
NJAC	New Jersey Administrative Code
NJDEP	New Jersey Department of Environmental Protection
NTCRA	Non-Time Critical Removal Action
O&M	operations and maintenance
OU	Operable Unit
OW	Office of Water
PA	Preliminary Assessment

PFAS	perfluorinated alkyl substances
PFOA	perfluorooctanoate (also perfluorooctanoic acid)
PFOS	perfluorooctane sulfonate
ppt	parts per trillion
PRM	Potomac-Raritan-Magothy
PWS	potable water system
RAO	Removal Action Objective
SDWA	Safe Drinking Water Act
SHPO	State Historic Preservation Officer
SI	Site Inspection
SRM	Sustainment, Restoration, and Modernization (funds)
TBC	to be considered
UCMR3	Third Unregulated Contaminant Monitoring Rule
USACE	U.S. Army Corps of Engineers
USAF	United States Air Force
U.S.C.	United States Code

1.0 Introduction

1.1 Purpose and Objective

The United States Air Force (USAF) will conduct a non-time critical removal action (NTCRA) to address per- and polyfluorinated alkyl substances (PFAS) contamination in the drinking water at Joint Base McGuire-Dix-Lakehurst (JB MDL), New Jersey; specifically, this NTCRA will reduce or eliminate PFAS contamination obtained from two shallow supply wells in the JB MDL-Lakehurst Hill potable water system (PWS: NJ1511010). This NTCRA will be performed in accordance with, and satisfies the requirements of, the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), Title 42 United States Code (U.S.C.) §9604, as further implemented by the National Contingency Plan (NCP), Title 40 Code of Federal Regulations (CFR) §300.415 (EPA, 1993). The USAF Installation Restoration Program (IRP) is authorized by the Defense Environmental Restoration Program (DERP) (10 U.S.C. 2701 et. seq.). The DERP is the environmental restoration program the military services use to conduct CERCLA response actions and satisfy CERCLA lead agency functions as delegated by Executive Order 12580 (AFI 32-7020). This engineering evaluation and cost analysis (EE/CA) has been prepared by CAPE Environmental Management Incorporated (CAPE), on behalf of the USAF, under U.S. Army Corps of Engineers (USACE), Omaha District, contract W9128F-18-D-0028.

This EE/CA identifies and evaluates proposed alternatives for completing the NTCRA. The EE/CA identifies removal action objectives (RAOs); identifies and evaluates potential alternatives for conducting the removal action; and recommends the best-suited removal action alternative. This removal action will provide a permanent solution to protect human health from exposure to perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) above the EPA lifetime Health Advisory (HA) of 0.07 micrograms per liter (µg/L) (individually or combined) in drinking water (EPA, 2016a; EPA, 2016b).

1.2 Report Organization

The remainder of this EE/CA is organized in the following sections:

- Section 2.0 provides site characterization information such as site description, site investigation, and a streamlined risk assessment.
- Section 3.0 defines RAOs and discusses applicable or relevant and appropriate requirements (ARARs) for the proposed removal action.
- Section 4.0 presents the identification and analysis of removal action alternatives.
- Section 5.0 provides a comparative analysis of removal action alternatives.
- Section 6.0 identifies the recommended removal action alternative.
- Section 7.0 provides references used in preparation of this report.

2.0 Site Characterization

2.1 Site Description and Background

JB MDL is a U.S. military facility 18 miles southeast of Trenton, New Jersey. The facility resulted from the October 1, 2009, merger of the USAFs McGuire Air Force Base (AFB), the Army's Fort Dix, and Naval Air

Engineering Station (NAES)-Lakehurst. JB MDL covers approximately 42,000 contiguous acres across Burlington and Ocean Counties, New Jersey (Figure 1).

The principal water table or surficial aquifer system at JB MDL is the Kirkwood-Cohansey aquifer and is composed of the Kirkwood and Cohansey Formations. The principal water supply aquifers at and surrounding JB MDL are from the deeper confined aquifers, extracted by municipalities to serve as drinking water for a large number of customers; the JB MDL Hill potable water system (PWS) coverage area is shown on Figure 2. The surficial aquifer is not a principal water supply aquifer; however, some local private wells may extract groundwater, as drinking water, from the shallow surficial aquifer, and several back-up drinking water wells are screened in the surficial aquifer. The surficial aquifer system underlying JB MDL is the most important with respect to the aqueous film-forming foam (AFFF) areas, as this is the aquifer most vulnerable to surface contamination.

A CERCLA screening level site inspection (SI) was conducted at JB MDL to assess 21 locations as areas of concern associated with releases of AFFF (Aerostar SES, 2019). Media evaluated at each area included surface soil (as applicable); subsurface soil (vadose zone in the source area); groundwater (including samples from existing monitoring wells, temporary wells, and/or direct push sampling), and surface water/sediment (as applicable). The SI Report, finalized in January 2019, documents that releases of PFOS/PFOA occurred at all 21 locations studied. Based on the SI and sampling of the on-base drinking water supply wells, PFOS and PFOA have been identified at concentrations exceeding the EPA lifetime HA of 0.07 µg/L (individually or combined) at multiple locations within the shallow Kirkwood-Cohansey aquifer at JB MDL-Lakehurst.

The USAF sampled all water supply wells at JB MDL, except the Dix Main water system, in the Fall of 2016 under a USAF enterprise-wide task for PFAS, including PFOS/PFOA. In summary, all of the results of the supply wells on JB MDL-McGuire and JB MDL-Dix and the deep well supplying JB MDL-Lakehurst were below laboratory detection limits. PFAS were detected in several of the shallow supply wells at JB MDL-Lakehurst at concentrations below the screening levels and EPA lifetime HA for PFOS and PFOA. Subsequent resampling of Lakehurst backup wells 5 and 9A in December 2016 revealed exceedances of the EPA lifetime HA. These shallow supply wells currently operate as back-up wells as part of the JB MDL-Lakehurst Hill PWS (NJ1511010).

2.2 Previous Removal Actions

An Ion-Exchange Resin treatment system was installed and brought into operation in April 2019 at JB MDL-Lakehurst to treat PFOS/PFOA contamination from wells 5 and 9A; however, this mitigation system was completed as an Air Force construction project rather than as a CERCLA project. The New Jersey Department of Environmental Protection (NJDEP) issued a Temporary Treatment Approval (WTA180001) on 20 February 2019 to treat PFOS and PFOA from wells 5 and 9A using ion exchange. Routine monitoring occurs to evaluate the effectiveness of the system. The ion exchange system is effective and treats PFOS/PFOA concentrations below the EPA lifetime HA. The temporary treatment approval expires on 28 February 2020.

2.3 Source, Nature, and Extent of Contamination

The precise source of PFOS and PFOA contamination in the shallow aquifer near wells 5 and 9A is unknown, but it may be related to several areas at JB MDL-Lakehurst where historical use of AFFF has been documented. AFFF was developed in the 1960s to extinguish petroleum fires. The USAF and Navy started using AFFF in approximately 1970. Because of their ability to put out fires and suppress re-ignition, use of AFFFs became widespread at airports, both military and civilian. AFFF, which contains PFOS/PFOA, would have been used during fire training exercises, during suppression of actual fires, and in fire suppression systems. These historical uses released AFFF to the ground surface at JB MDL, where the AFFF could migrate through the soil to the underlying groundwater. Other common sources of PFOS

and PFOA include manufacturing facilities, areas where industrial waste was disposed of, municipal solid waste landfills, and wastewater treatment facilities.

In May 2014, limited site investigations were conducted to determine the presence or absence of PFAS in the environment, including PFOS/PFOA. These initial site investigations were restricted to four sites with confirmed or suspected releases of PFAS-containing materials, that were in proximity to active Environmental Restoration Program operable units (OUs), and could be accessed with minimal impact to Base operations; this limited SI was completed as a USAF enterprise-wide study to evaluate potential PFOS/PFOA impacts at all Air Force bases (SCF, 2015).

A Preliminary Assessment (PA) was performed at JB MDL in 2015 which identified potential PFAS discharges and/or contamination to site media, in particular groundwater, where AFFF was used, tested, stored, or discharged (HGL, 2015). The PA identified thirty-four (34) sites. These 34 sites were grouped into 21 Areas of Concern (or AOCs) during the subsequent JB MDL SI because of proximity to the suspected releases. A CERCLA screening level SI was subsequently conducted at JB MDL between August and September 2016 to assess 21 locations as areas of concern associated with releases of AFFF (Aerostar SES, 2019). The SI Report, finalized in January 2019, documents that releases of PFOS/PFOA occurred at all 21 locations studied.

In addition to the CERCLA investigation, per Assistant Secretary of the Air Force (Installations, Environment, and Energy) Memorandum - *Testing Drinking Water for Perfluorooctane Sulfonate (PFOS) and Perfluorooctanoic Acid (PFOA) (17 June 2016),* JB MDL sampled all on-base potable drinking water sources in 2016, regardless of depth, as described above. PFOS was detected above the EPA lifetime HA in shallow drinking water wells 5 and 9A; while PFOA was detected below the EPA lifetime HA individually, it exceeded the EPA lifetime HA when combined with PFOS pursuant to the EPA lifetime HA for PFOS/PFOA.

2.4 Analytical Data

Although no plumes have been fully characterized, wells 5 and 9A are hydraulically located between currently identified source(s) and currently identified off-base impacted areas. An Expanded Site Investigation (ESI) began in 2017 under a Rapid Response contract and will continue in 2019 under an ESI contract. The ESI activities may help determine the source(s) of the PFOS/PFOA currently impacting shallow drinking water wells 5 and 9A; however, remediation of the source(s) and downgradient groundwater will not occur immediately, as characterization of the source(s) and plume(s) will follow the CERCLA process, including a decision document and remedial design.

PFOS and PFOA contamination was detected above the EPA lifetime HA in drinking water samples collected from two shallow drinking water wells at JB MDL-Lakehurst (wells 5 and 9A) in December of 2016. The maximum concentrations of PFOS and PFOA were 0.170 µg/L and 0.045 µg/L, respectively. The shallow supply wells currently operate as back-up wells as part of the JB MDL-Lakehurst Hill PWS (NJ1511010). For security reasons, the exact locations of the wells are not shown in this EE/CA.

2.5 Streamlined Risk Evaluation

The USAF identified the presence of PFOS/PFOA above the EPA lifetime HA in drinking water wells 5 and 9A. The EPA established lifetime HA values in 2016 that the USAF is using as benchmarks to determine if response actions are needed. The EPA lifetime HA is in place since research has identified that there is potential risk to human health as a result of exposure to PFAS and regulatory standards are currently under consideration. EPA lifetime HA values are developed to provide information in response to an urgent or rapidly developing situation. The EPA lifetime HA values reflect reasonable, health-based hazard concentrations above which action should be taken to reduce exposure to unregulated contaminants in drinking water. Neither PFOS nor PFOA are listed CERCLA hazardous substances (40 CFR Part 302, Table 302.4). However, the USAF has determined that PFOS and PFOA are “CERCLA

pollutants or contaminants." CERCLA defines pollutant or contaminant as essentially any chemical that "…upon exposure, ingestion, inhalation or assimilation into any organism, either directly from the environment or indirectly by ingestion through food chains, will or may reasonably be anticipated to cause death, disease, behavioral abnormalities, cancer, genetic mutation, physiological malfunctions (including malfunctions in reproduction) or physical deformation in such organisms or their offspring…" (42 U.S.C. § 9601(33)).

3.0 Identification of Removal Action Objectives and Applicable or Relevant and Appropriate Requirements

This section identifies the statutory framework of removal actions and determines the removal scope based on RAOs, ARARs, and cleanup criteria.

3.1 Statutory Framework

This removal action will be performed pursuant to the CERCLA and the NCP under the authority delegated by the Office of the President of the United States through Executive Order (EO) 12580 as re-delegated. This order, as implemented through Department of Defense Instruction (DoDI) 4715.07 and Department of Defense Manual (DoDM) 4715.20 as amended, provides USAF with authorization to conduct removal actions. DERP provides funding to USAF for removal actions conducted under CERCLA. This removal action is non-time critical, because 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. Because this is not an EPA Superfund-lead site, the $2 million and 12-month statutory limits for Superfund-financed removal actions pursuant to Section 104(c)(1) of CERCLA do not apply.

This EE/CA provides an analysis of three removal alternatives for the site and recommends a removal action alternative. This EE/CA complies with the requirements of CERCLA, the Superfund Amendments and Reauthorization Act, NCP, the Defense Environmental Restoration Program, and EO 12580. This EE/CA is undertaken pursuant to Title 40 of the Code of Federal Regulations (40 CFR), Part 300.415(b)(4)(i). The requirements for this EE/CA and its mandated public comment period provide an opportunity for public input with regard to the cleanup process.

3.2 Scope of the Removal Action

The scope of this removal action is to provide clean drinking water for JB MDL-Lakehurst by eliminating PFOS and PFOA concentrations in the finished drinking water to below EPA lifetime HA levels.

3.2.1 Removal Action Objectives

RAOs specify what the proposed removal action is expected to accomplish. In other words, they define the goals for the removal action. As such, RAOs are site-specific and are influenced by the nature and extent of chemical contamination, current and potentially threatened resources, and the potential for human and environmental exposure. Based on the scope of the removal action, the following RAO was developed:

- Eliminate the human health risk posed by PFOS/PFOA-contaminated water above the EPA lifetime HA used as drinking water from JB MDL-Lakehurst wells #5 and #9A.

3.2.2 Applicable or Relevant and Appropriate Requirements

Pursuant to 40 CFR Part 300.415(j), this removal action "shall, to the extent practicable considering the exigencies of the situation, attain applicable or relevant and appropriate requirements under federal environmental or state environmental or facility siting laws.". "Applicable requirements" are those cleanup standards, standards of control, and other substantive environmental protection requirements,

criteria, or limitations promulgated under Federal or state law that specifically address hazardous substances, pollutants, contaminants, location, or other circumstances found at a CERCLA site (which for purposes of this EE/CA includes JB MDL's underground drinking water sources). A Federal cleanup requirement that pertains to a CERCLA site is "applicable." State requirements associated with a site are not "applicable" unless they are more stringent than applicable Federal requirements. If a cleanup standard or requirement is not "applicable," then it is evaluated to determine whether it is "relevant and appropriate."

"Relevant and appropriate requirements" are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or state law that, while not "applicable" to the response action to a hazardous substance, pollutant, contaminant, location, or other circumstance at a CERCLA site, address problems or situations similar to the circumstances at the CERCLA site, and their use is well suited to the particular site. Only state standards that are more stringent than Federal requirements may be "applicable" or "relevant and appropriate."

The criteria for determining if a standard or requirement is "applicable" or "relevant and appropriate" are listed in 40 CFR § 300.400(g)(2):

- The purpose of both the requirement and the CERCLA action;
- The medium regulated or affected by the requirement and the medium contaminated or affected at the CERCLA site;
- The substances regulated by the requirement and the substances found at the CERCLA site;
- The actions or activities regulated by the requirement and the response action contemplated at the CERCLA site;
- Any variances, waivers, or exemptions of the requirement and their availability for the circumstances at the CERCLA site;
- The type of place regulated and the type of place affected by the release or CERCLA action;
- The type and size of structure or facility regulated and the type and size of structure or facility affected by the release or proposed in the CERCLA action; and
- Any consideration of use or potential use of affected resources in the requirement and the use or potential use of the affected resources at the CERCLA site.

As defined in *CERCLA Compliance with Other Laws Manual* (EPA, 1988), ARARs stipulate a requirement may be "applicable" or "relevant and appropriate," but not both. ARARs must be identified on a site-specific basis and involve a two-part analysis: first, it must be determined whether a given requirement is applicable; then, if it is not applicable, it must be determined whether it is both relevant and appropriate. When the analysis determines that a requirement is both relevant and appropriate, such a requirement must be complied with to the same degree as if it were applicable.

Furthermore, only those state requirements or standards that are promulgated, identified by the state in a timely manner, and are more stringent than Federal requirements or standards may be "applicable" or "relevant and appropriate." In this context, "promulgated" means that the standards are of general applicability and are legally enforceable.

In addition to ARARs, advisories, criteria, or guidance may be identified as to be considered (TBC) material. These advisories, criteria, or guidance are developed by EPA, other Federal agencies, or states, and may be useful in developing the removal action. An example of a TBC item is the EPA lifetime HA action levels for PFOS and PFOA developed by EPA. TBC material complement ARARs, but do not override them.

To constitute an ARAR, a requirement must be substantive. Therefore, only the substantive provisions of requirements identified as ARARs in this analysis are considered to be ARARs. Provisions of generally relevant Federal and state statutes and regulations determined to be procedural or non-environmental, including permit requirements, are not considered to be ARARs.

Pursuant to EPA guidance, ARARs are generally divided into three categories: chemical-, location-, and action-specific requirements:

- **Chemical-Specific ARARs** usually are either health- or risk-based methodologies or numerical values that limit the amount or concentration of a chemical that may remain in or be discharged to the environment. If, in a specific situation, a chemical is subject to more than one discharge or exposure limit, the more stringent of the requirements should generally be applied.
- **Location-Specific ARARs** generally are requirements that limit concentrations of chemicals or restrict certain activities solely because of geographical or land use concerns. These requirements may limit the boundaries of the remedial action and may impose additional constraints on the cleanup action. For example, location-specific ARARs may restrict activities in the vicinity of wetlands, floodplains, sensitive ecosystems or habitats, or areas of historical or cultural significance. For this removal action, the only part of the removal action that is taking place "onsite" is the disconnection of wells 5 and 9A from the JB MDL-Lakehurst Hill PWS and their decommissioning. All other work associated with the removal action should be considered "off-site."
- **Action-Specific ARARs** are requirements that apply to specific actions that may be associated with site cleanup. They usually are restrictions on the conduct of certain activities or the operation of certain technologies at a specific site. These include, for example, acceptable handling, treatment, and disposal procedures for hazardous substances, and requirements for erosion and sediment control during construction of treatment system buildings.

Potential ARARs and TBC requirements for the removal action are presented in Tables 3-1 and 3-2, respectively. Proposed removal action alternatives are evaluated with respect to compliance with ARARs. The identification of ARARs is an iterative process, and the final determination of ARARs will be made in the Action Memorandum (AM), which will be submitted after public review of this EE/CA as part of the selection process for this response action. The AM is the primary Decision Document for NTCRAs and provides a concise, written record of the decision to select an appropriate removal action. It substantiates the need for a removal action, identifies the proposed action, and explains the rationale for the removal action selection.

TABLE 3-1
Identification of Potential ARARs
EE/CA for NTCRA at Joint Base McGuire-Dix-Lakehurst, New Jersey

Federal or State Statute, Regulation, or Guidance	Requirement	Type of ARAR	Actions to be Taken to Attain Requirement
New Jersey Administrative Code (NJAC) 7:9D (Well Construction, Maintenance, Sealing of Abandoned Wells)	Identifies the State requirements for well construction and decommissioning.	Applicable	The required well construction and decommission plan(s) will be submitted to and approved by NJDEP. The wells will be constructed and/or seals pursuant to the requirements.

TABLE 3-1
Identification of Potential ARARs
EE/CA for NTCRA at Joint Base McGuire-Dix-Lakehurst, New Jersey

Federal or State Statute, Regulation, or Guidance	Requirement	Type of ARAR	Actions to be Taken to Attain Requirement
NJAC 7:10-11 (Safe Drinking Water Act) and 7:19 (Water Allocation Permit Rules)	Identifies the construction and permit requirements under the State Safe Drinking Water Act and Water Allocation Rules. The new treatment building is considered a Major Modification requiring NJDEP review and approval. Limitations to the volume of groundwater to extract for drinking water must meet aquifer limitations and requirement.	Relevant and Appropriate	The required construction/design plan and permit for the treatment system will be obtained prior to distribution. The expected extraction rate of the new pumps are within JB MDL's Allocation Permit limitations.
The National Historical Preservation Act and implementing regulations, 54 U.S.C. 300101-307108; 36 CFR 800 Subpart B.	Requires that Federal agencies take actions to avoid adverse effects on historic properties.	Applicable	New well and treatment building will be constructed within the JB MDL-Lakehurst Lighter than Air historic district. State Historic Preservation Officer (SHPO) coordination will occur prior to construction to avoid adverse effects to historic properties and ensure compliance with historic district requirements.

TABLE 3-2
Identification of TBCs
EE/CA for NTCRA at Joint Base McGuire-Dix-Lakehurst, New Jersey

Federal or State Statute, Regulation, or Guidance	Requirement	To-Be Considered	Actions to be Taken to Attain Requirement
Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS), EPA Docket No. 822-R-16-004 (EPA, May 2016) Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA), EPA Docket No. 822-R-16-005 (EPA, May 2016)	Provides drinking water system operators information on the health risks of PFOS and PFOA and recommendations about reducing exposure to PFOS and PFOA in drinking water. Establishes EPA lifetime HA action level for PFOS and PFOA concentrations, individually or in combination, of 0.07 µg/L.	Health advisories are not "Applicable" or "Relevant and Appropriate". These are TBC because they provide response criteria that are useable in the absence of ARARs.	The EPA lifetime HA will be the concentration that the removal action is designed to achieve.

3.3 Removal Action Criteria

The removal action criteria are the contaminant concentrations that the removal action alternative must achieve. As noted in Table 3-1, there are no chemical-specific ARARs for PFOS and PFOA that can be used as criteria. In the absence of chemical-specific ARARs, the current EPA lifetime HA level of 0.07 µg/L

(70 ppt) for the combined PFOS and PFOA concentration is the removal action criterion; identified as a TBC.

3.4 Removal Schedule

JB MDL intends to initiate the removal action in 2019 once all required regulatory documents, plans, and permits are approved.

3.5 Planned Remedial Activities

At this time, specific remedial activities are not planned because investigation of the potential source area(s) is ongoing. Until the source(s) and migration pathways between the source(s) and drinking water wells are characterized, potential remedial activities cannot be identified.

4.0 Identification and Analysis of Removal Action Alternatives

This section identifies removal action alternatives that could achieve the RAO, and evaluates each removal action alternative in terms of effectiveness, implementability, and cost. EPA guidance on NTCRAs provides the following guidance about effectiveness, implementability, and cost:

- **Effectiveness:** An alternative's effectiveness is its ability to meet the objective within the scope of the removal action. This criterion considers protection of public health, the community, workers during implementation, and the environment; and compliance with ARARs. The following factors are also considered:
  - 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, which addresses the effects of the alternative during implementation before the RAO has been met.
- **Implementability:** This criterion evaluates the technical and administrative feasibility of each alternative, and the availability of the services and materials needed to implement the alternative. This criterion also considers state and community acceptance. The acceptance of an alternative will be evaluated during the public comment period and preparation of the AM. The final version of this EE/CA will be made available for a 30-day public comment period, and all comments received will be summarized and addressed in the responsiveness summary section of the AM.
  - Technical feasibility: the ability of the technology to implement the remedy and the technology's reliability. Technical feasibility is evaluated from construction through operation and maintenance of the removal action. This factor also evaluates whether an alternative will contribute to the anticipated performance of any remedial activity.
  - Administrative feasibility: this factor evaluates those activities needed to coordinate with other offices and agencies, the need for permits, adherence to applicable non-environmental laws, and concerns of other regulatory agencies.
  - Availability of services and materials: this factor considers whether the requisite personnel, equipment, and materials will be available during the removal action schedule; the adequacy of off-site treatment capacity if the alternative includes off-site removal and treatment of waste; and whether the technology has been sufficiently developed for full-scale application.

- **Cost:** The direct and indirect capital, operation, and maintenance costs are estimated for each alternative. Costs are calculated on a present value basis for any removal action lasting longer than 12 months.

4.1 Removal Action Alternatives

Three removal action alternatives were developed:

- Alternative 1: No action.
- Alternative 2: Maintain the ex-situ ion-exchange resin treatment system as a long-term solution for wells 5 and 9A.
- Alternative 3: Install a replacement deep well and treatment building, decommission wells 5 and 9A, and demolish the existing treatment building.

4.1.1 Alternative 1 – No Action

With this alternative, no treatment would be implemented for back-up wells 5 and 9A, which would leave the base with no back-up capability should the existing main deep well become inoperable. This alternative was evaluated to provide a baseline against which to compare the other alternatives.

Effectiveness: The no-action alternative would not be protective of the public and the community. Because there is no direct or indirect pathway of contaminated groundwater to surface water, there is no risk to the environment under the status quo. This alternative would not affect workers in the short-term, because no action would be taken. This alternative would not trigger location-specific ARARs (e.g., National Historical Preservation Act) or action-specific ARARs. However, the no-action alternative would not comply with all ARARs or achieve RAOs.

Implementability: In the short-term, the no-action alternative is readily implementable. No skilled labor, specialty equipment, or materials are needed to maintain the status quo.

Cost: There is no cost associated with Alternative 1.

4.1.2 Alternative 2 – Mitigate Wells 5 and 9A Using Ion Exchange

Ion exchange is a well-established technology for the removal of either positively-charged (cation exchange) or negatively-charged (anion exchange) chemicals from water. Both PFOS and PFOA have a negatively charged end that can associate with the anion exchange resin. Similar to granular activated carbon (GAC), a vessel or tank is filled with the ion exchange resin. As the contaminated water flows through the vessel, the anions in the groundwater, including PFOS and PFOA, associate with the resin. Once the exchange sites are filled, the resin can no longer remove PFOS and PFOA from the water, and the spent resin is replaced with fresh resin. Similar to GAC, the spent ion exchange resin is incinerated to ensure that the PFOS and PFOA molecules are completely destroyed. The ion exchange resins used for PFOS and PFOA can also remove other anions from the groundwater. Nitrate and sulfate are examples of anions commonly found in groundwater that can be removed by these resins. The presence of other anions that can compete for the exchange sites on the resin is considered during design of an ion exchange system. Ion exchange is of a moderate cost to install, operate, and maintain; and it is easy to manage and dispose of the associated waste stream (i.e., spent resin).

Effectiveness: Initial sample results indicate that ion exchange is protective of public health. Any potential risks to human health during ongoing maintenance would be mitigated through use of standard construction safety protocols. Thus, Alternative 2 is protective of workers.

All construction activities would comply with location-specific and action-specific ARARs. By decreasing PFOS and PFOA concentrations in the extracted groundwater to less than the action levels, this alternative would achieve the RAO.

Through proper operation and maintenance (O&M) including routine monitoring of resin to evaluate effectiveness, ion exchange offers a long-term effective solution. PFOS and PFOA would be permanently removed from the extracted groundwater and transferred to the ion exchange resin. When spent, the resin would be incinerated, thereby destroying the PFOS and PFOA molecules. Through the ion exchange and incineration processes, this alternative would decrease contaminant mobility, volume, and toxicity in finished drinking water. Within shallow groundwater, mobility, volume, and toxicity are slightly reduced when the system is in operation; however, the system is only operated when drinking water is needed from the back-up system and would not fully capture and prohibit further downgradient migration of the plume.

As noted above, any potential risks to workers in the short-term would be those associated with conventional construction projects. Such risks can be readily managed through standard practices.

Implementability: Ion exchange is a well-established treatment technology that is routinely used for drinking water treatment and groundwater treatment.

Alternative 2 is administratively feasible, as it has already been implemented. The labor, equipment, and materials needed to operate and maintain an ion exchange treatment system are readily available. Ion exchange is used to remove a wide range of chemicals from water. Use of resins selective for PFOS and PFOA is relatively new, but pilot-testing and full-scale systems indicate this technology is highly effective for PFOS and PFOA removal.

Cost: The cost analysis is based on a single treatment system that is operated for 30 years. The present value analysis for the 30-year life-cycle cost is based on a discount rate of 3 percent. The cost estimate is summarized in Table 4-1, and details are provided in the Cost Analysis in Appendix A.

The capital cost, including project management, construction management, and contingencies, was $927,000. The ion exchange system was installed in February 2020 under emergency circumstances, outside of CERCLA, using Air Force Sustainment, Restoration, and Modernization (SRM) funds. The capital cost are included in this EE/CA to provide an equally comparative cost analysis with the other alternatives. The annual O&M costs for the mitigation system itself includes equipment maintenance, routine monthly monitoring for PFOS/PFOA, acquisition of new resin annually, and disposal of spent resin. The annual O&M costs are estimated to be $290,000. The net present value of the capital, operating, and maintenance costs combined is estimated to be $6,611,128.

TABLE 4-1
Cost Summary of Alternative 2
EE/CA for NTCRA at Joint Base McGuire-Dix-Lakehurst, New Jersey

Install IX System	$927,000
Annual Operations and Maintenance	$290,000
Total Operational Present Value*	$5,584,128
ALTERNATIVE 3 TOTAL	**$6,611,128**

4.1.3 Alternative 3 – Decommission Wells 5 and 9A

This alternative requires installing a new water supply well as a water source to replace wells 5 and 9A. The new supply well would be installed within the Upper Aquifer of the confined Potomac-Raritan-Magothy (PRM) aquifer system, extending approximately 900 feet (ft) below ground surface (bgs) in the JB MDL-Lakehurst area. Water from the well would be treated and stored in the existing 300,000-gallon elevated water tank. The scope includes designing and installing a new supply well, pump, controls, and plumbing; designing and building a new drinking water treatment building, commissioning the new water source, and subsequently decommissioning wells 5 and 9A. The Air Force would design and construct the new treatment building and equip it to treat the water to meet the NJDEP Safe Drinking

Water Act requirements and complete shakedown and commissioning prior to removing wells 5 and 9A from service.

Effectiveness: Existing on-site data from the existing JB MDL-Lakehurst Main System indicate that groundwater from the deep, confined PRM aquifer system is not contaminated with PFOS/PFOA; therefore, this alternative would be protective of public health as human exposure to PFOS/PFOA in drinking water would be eliminated. Any potential risks to human health during well installation would be mitigated through use of standard construction safety protocols. Thus, Alternative 3 would be protective of workers.

Appendix A presents Figure 3, excerpted from the Engineer's Report which is included with the application for the Permit to Construct, showing the generalized hydrostratigraphy. The location and depth of the proposed new supply well is sketched on the figure and shows that the proposed well will be completed in the Upper Aquifer of the PRM aquifer system, which is protected by four confining units ranging up to approximately 200 feet thick. In addition, Appendix A also includes Drawing No. C-8 from the design drawings that indicate the well will be installed as a double-cased well with the outer casing set and grouted approximately 110 feet bgs into the Composite Confining Unit at the base of the Cohancey Aquifer. The inner casing will be set and grouted approximately 912 feet bgs into the Merchantville-Woodbury confining unit.

All construction activities would comply with location-specific and action-specific ARARs. By eliminating PFOS and PFOA concentrations in the extracted groundwater to less than the action levels, this alternative would achieve the RAO.

Decommissioning wells 5 and 9A offers an effective long-term solution to eliminate PFOS/PFOA from JB MDL-Lakehurst drinking water.

Implementability: The labor, equipment, and materials needed to replace the water supply wells are readily available; a USACE contract is in place with sufficient Air Force funding to complete this work starting in 2019.

Cost: The estimated cost of the well replacement is $4,155,795. A cost breakdown is presented in Table 4-2 below, and the detail is included in the Cost Analysis in Appendix B. This alternative includes capital costs only as no future O&M mitigation costs would be associated with the well and treatment system. After installation, the O&M would be funded and managed by JB MDL in accordance with the New Jersey Safe Drinking Water Act, and there would be no further required CERCLA costs.

TABLE 4-2
Cost Summary of Alternative 3
EE/CA for NTCRA at Joint Base McGuire-Dix-Lakehurst, New Jersey

Planning/Labor	$470,000
Site Work (Survey, utilities)	$20,795
Well Installation	$1,485,000
Treatment Building Installation	$1,150,000
Well Testing (Pump and water quality)	$845,000
Well & Treatment System Commissioning	$10,000
Shallow Well Decommissioning	$75,000
Demolish Existing Treatment Building	$100,000
ALTERNATIVE 3 TOTAL	**$4,155,795**

5.0 Comparative Analysis of Removal Action Alternatives

5.1 Effectiveness

As described above, the No-Action alternative would leave the base with no back-up capability should the existing main deep well become inoperable. Based on this uncertainty, Alternative 1 has the lowest effectiveness of the three alternatives. In addition, Alternative 1 would not decrease contaminant mobility, toxicity, or volume. Alternative 1 would not meet the RAO or ARARs but is included as a baseline for comparison of other alternatives.

Alternatives 2 and 3 have similar degrees of effectiveness and would each meet the RAO and ARARs. Alternative 2, ion exchange, effectively removes PFOS and PFOA from the on-base drinking water based on results from the operation of the system that is already installed. This alternative decreases contaminant toxicity, mobility, and volume through concentrating PFOS and PFOA on the ion exchange resin and incinerating the spent media. Alternative 2 decreases toxicity, mobility, and volume in shallow groundwater when in use; however, the mitigation system is not intended to be operated continuously to create hydraulic control of the PFOS/PFOA-contaminated groundwater plume or treat the groundwater. In the long term, Alternative 2 would be effective provided proper O&M of the treatment system is continued. Alternative 3, does not treat or mitigate any PFOS/PFOA-contaminated shallow groundwater. Alternative 3, decommissioning wells 5 and 9A, would replace the water source with uncontaminated deep confined groundwater from the PRM aquifer, effectively eliminating human exposure to PFOS/PFOA from the shallow Kirkwood-Cohansey aquifer, thus eliminating the need for engineering control.

Both Alternatives 2 and 3 have similar short-term effectiveness. For both alternatives, the short-term risks to workers are those associated with conventional construction projects that can be mitigated through standard health and safety practices.

5.2 Implementability

All three alternatives are readily implementable. Alternative 1 requires no implementability effort but does not meet the RAO or ARARs. Alternative 2 has already been implemented, as of April 2019, and requires less construction compared to Alternative 3 because the mitigation system was prefabricated and only required minimal utility connections to the back-up system. However, Alternative 2 also requires long-term O&M including monitoring of PFOS/PFOA, acquisition of new resin annually, and disposal of the spent resin whereas Alternative 3 does not require long term O&M related to PFOS/ PFOA mitigation. Alternative 3 is readily implementable using routine drilling and construction techniques.

5.3 Costs

The cost of Alternative 1 (No Action) was $0. The cost of Alternative 2 (ion exchange) was estimated at $6,611,128 over an implementation period of 30 years. The cost of Alternative 3 (decommissioning wells 5 and 9A) is estimated at $4,155,795. Although Alternative 2 has already been implemented and has a lower capital cost, the present value long-term O&M cost, with an annual discount rate included, significantly exceeds the capital cost of Alternative 3; therefore, Alternative 3 is less expensive than Alternative 2.

6.0 Recommended Removal Action Alternative

As described in Section 5, Alternative 1 would not meet the RAO or ARARs and is, therefore, the least effective of the three removal action alternatives. For this reason, Alternative 1 is not recommended.

Alternatives 2 and 3 are similar in their effectiveness and implementability. Alternative 3 is less expensive on a present value basis than Alternative 2. In addition, Alternative 3 mitigates drinking water quality excursions due to IX treatment system failure and liability for long-term management of PFAS-contaminated media. Based on cost and reduced overall risk, Alternative 3 is the recommended removal action alternative.

7.0 References

Aerostar SES, 2019. *Final Site Inspections Report of Fire Fighting Foam Usage at Joint Base McGuire-Dix-Lakehurst Burlington and Ocean Counties, New Jersey*. January.

HydroGeologic (HGL) 2015. *Final Preliminary Assessment Report for Perfluorinated Compounds at Joint Base McGuire-Dix-Lakehurst, New Jersey*. August.

AFI 32-7020, The Environmental Restoration Program, November 7, 2014, incorporating Change 1, April 18, 2016.

DoDI 4715.07, Defense Environmental Restoration Program (DERP), May 21, 2013.

DoDM 4715.20, Defense Environmental Restoration Program (DERP) Management, March 9, 2012, as updated.

EPA, 1993. Guidance on Conducting Non-Time Critical Removal Actions Under CERCLA. EPA 540-R-93-057. August.

SAF/IE Memorandum, Testing Drinking Water for Perfluorooctane Sulfonate (PFOS) and Perfluorooctanoic Acid (PFOA), 17 June 2016

EPA, 1998. CERCLA Compliance with Other Laws Manual. EPA 540-G-89-006. August.

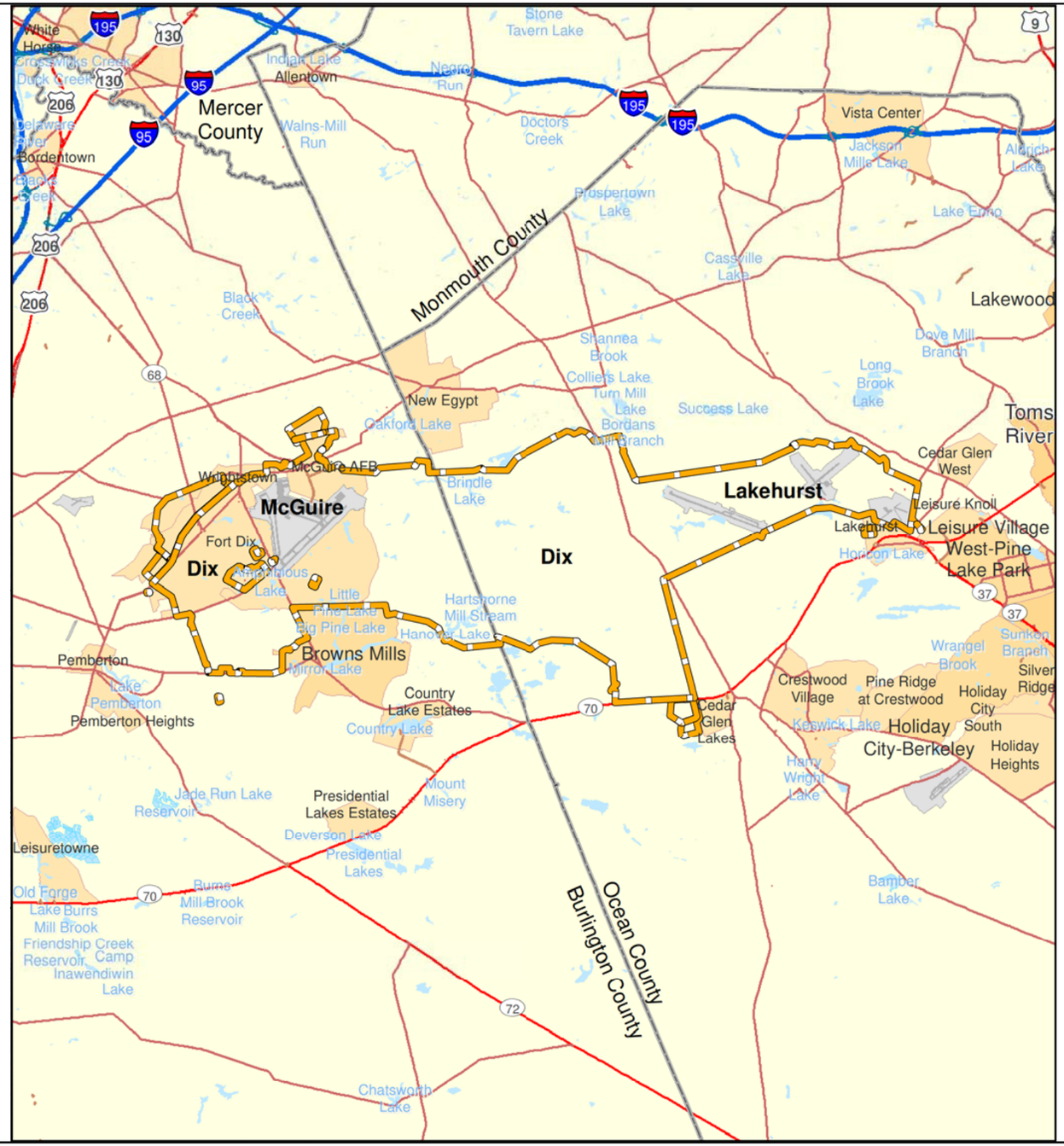
EPA, 2016a. *Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA).* EPA 822-R-16-005, May.

EPA, 2016b. *Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS*). EPA 822-R-16-004, May.

JB MDL, 2017. Integrated Cultural Resource Plan. Sept 2017.

SES Construction and Fuel Services (SCF) 2015, Final Site Investigation Report for Site Investigations of Fire Fighting Foam Usage at Various Air Force Bases in the U.S. for JB MDL, Burlington County, New Jersey. January.

FIGURES



LEGEND

County Line

Installation Boundary

N

0 5 Miles

PROJECT NAME

Non-Time Critical Removal Action

Joint Base McGuire-Dix-Lakehurst New Jersey

DOCUMENT TITLE

Engineering Evaluation and Cost Analysis

Water Supply Well Replacement

SHEET TITLE

Figure 1 Location of Joint Base McGuire-Dix-Lakehurst, Burlington & Ocean Counties, New Jersey

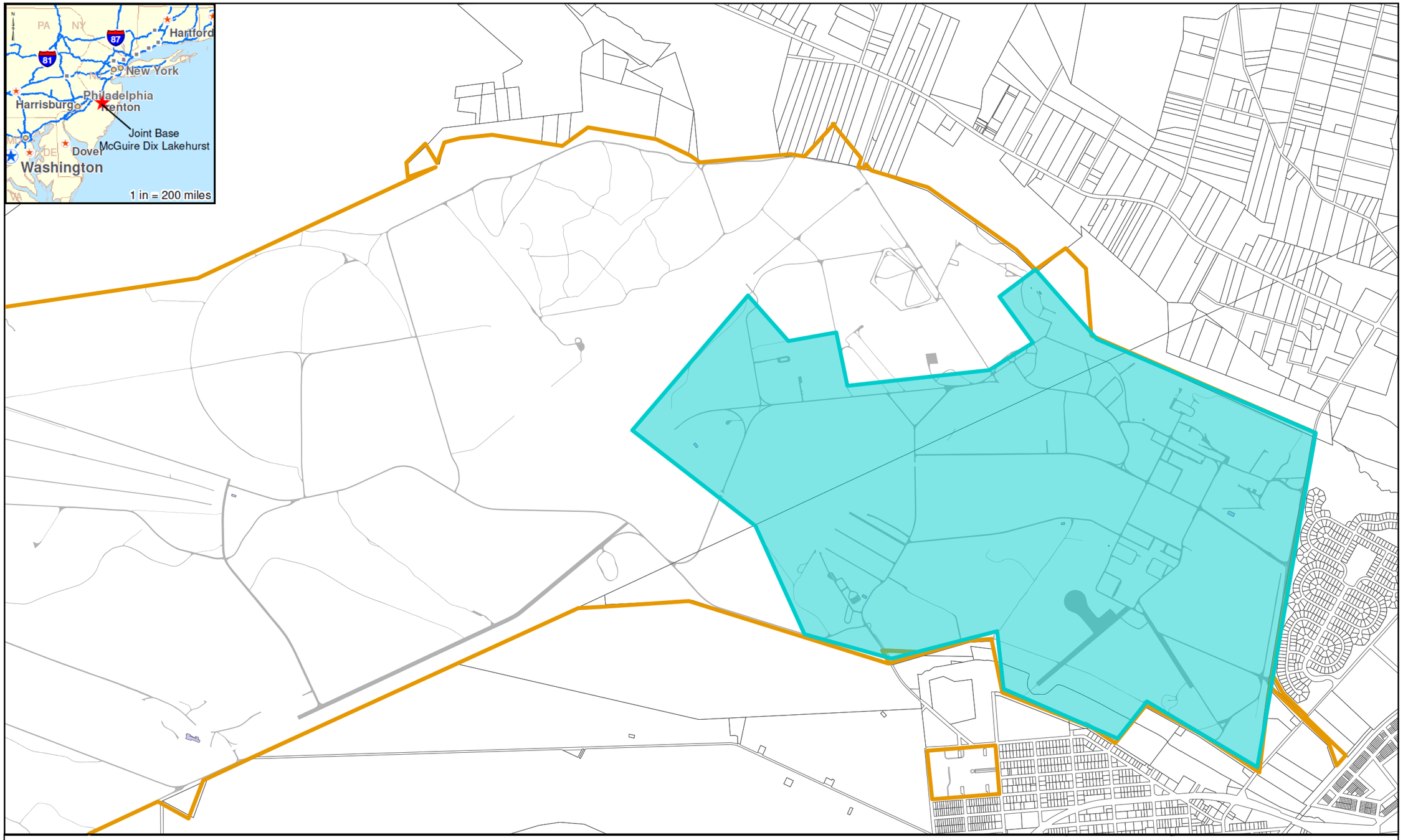
CONTRACT NO.
W9128F-18-D-0028

DELIVERY ORDER:
0136

DRAWN BY:
B. von Oppenfeld

REVIEWED BY:
M. Greenwald

DATE:
May 2019



LEGEND

Joint Base McGuire-Dix-Lakehurst Boundary

JB MDL Hill PWS
Drinking Water Coverage Area

Roads

N

0 0.5 1 Miles

Note: Scale is approximate

PROJECT NAME

Non-Time Critical Removal Action

Joint Base McGuire-Dix-Lakehurst New Jersey

DOCUMENT TITLE

Engineering Evaluation and Cost Analysis

Water Supply Well Replacement

SHEET TITLE

Figure 2
Drinking Water Coverage Area

CONTRACT NO.
W9128F-18-D-0028

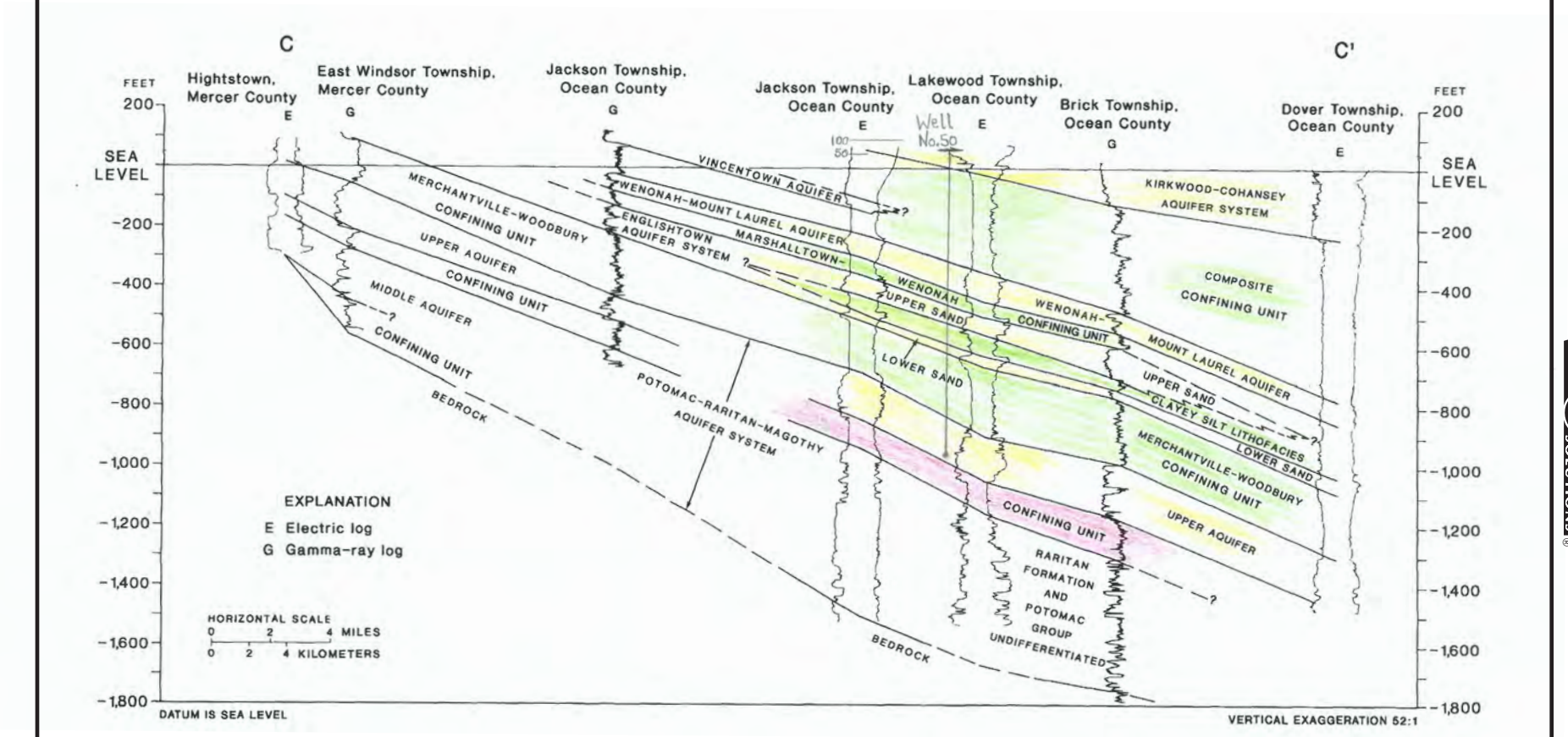
DELIVERY ORDER:
0136

DRAWN BY:
B. von Oppenfeld

REVIEWED BY:
M. Greenwald

DATE:
July 2019

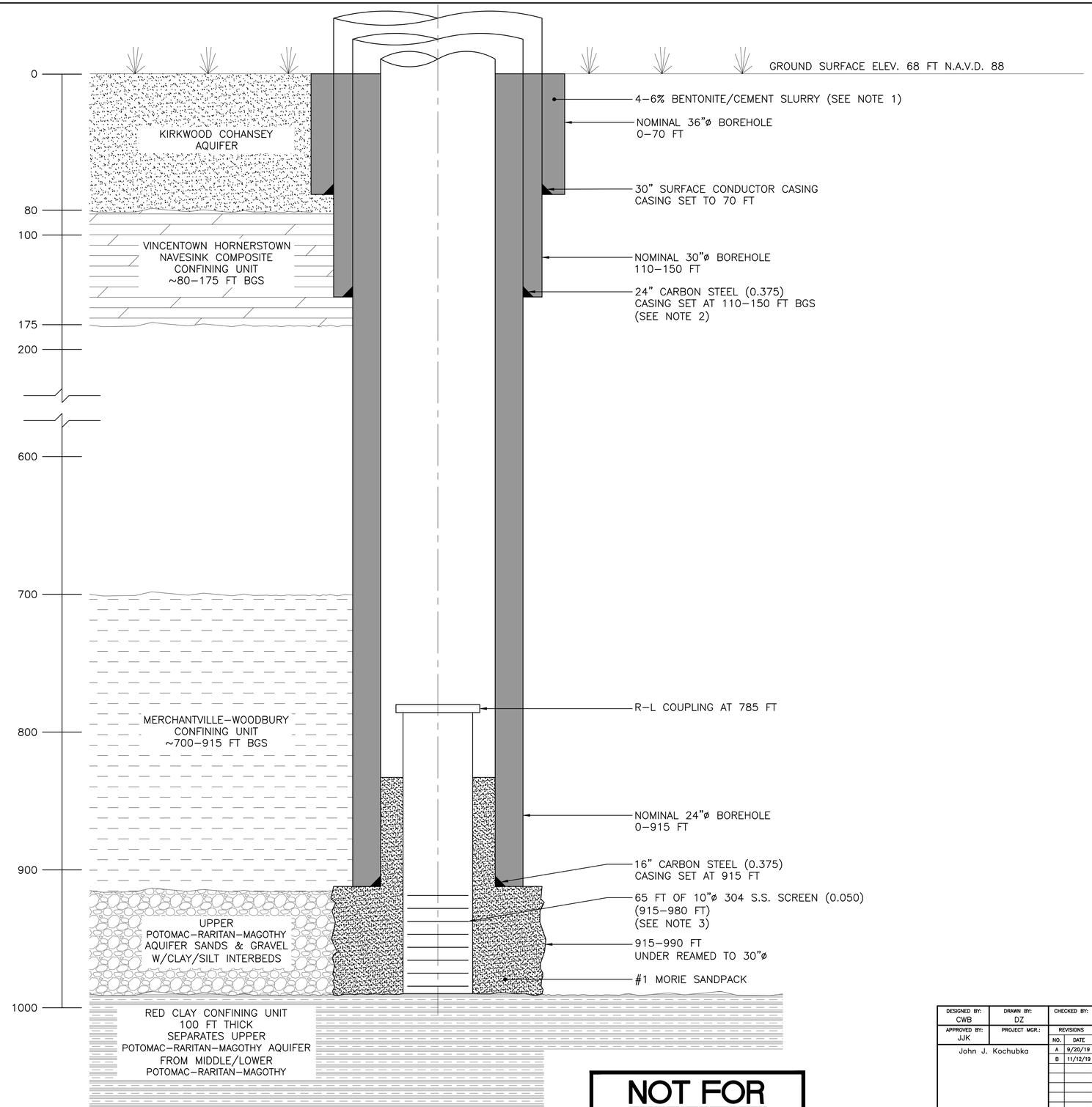
APPENDIX A
EXCERPTS FROM ENGINEERING REPORT AND DESIGN DRAWINGS



Source: (Zapecza, 1989)

19P-0321

FIGURE 3 - HYDROGEOLOGIC SECTION SHOWING THE STRATIGRAPHIC UNITS OF THE NEW JERSEY COASTAL PLAIN AND THE PROPOSED WELL NO.50



WELL DETAIL
SCALE: N.T.S.

NOTE:

1. ALL ANNULAR SPACES FOR 36", 30", AND 24" BOREHOLES SHALL BE GROUTED WITH 4–6% BENTONITE/CEMENT SLURRY.
2. THE 24" CASING WILL BE SET INTO THE COMPOSITE CONFINING UNIT UNDERLYING THE COHANSEY AQUIFER. CASING DEPTH WILL BE VERIFIED BY BOREHOLE GEOPHYSICAL LOGS.
3. FINAL WELL SCREEN INTERVALS AND CASING DEPTHS TO BE DETERMINED BY BOREHOLE GEOPHYSICAL LOGGING RESULTS.

NOT FOR CONSTRUCTION

NO.	DATE	APPR.	REVISION
B	11/12/19	JJK	WELL CASING REVISION
A	9/20/19	JJK	ISSUED FOR PERMIT

DESIGNED BY: CWB	DRAWN BY: DZ	CHECKED BY:	USACE OMAHA DISTRICT PFOS/PFOA/PFNA SAMPLING AND MITIGATION JOINT BASE MCGUIRE–DIX–LAKEHURST NEW JERSEY
APPROVED BY: JJK	PROJECT MGR.: John J. Kochubka	REVISIONS NO. A 9/20/19; B 11/12/19	SUPPLY WELL DETAIL
FILE:	NJ PROFESSIONAL ENGINEER 24GE04443400	SCALE: N.T.S.	DATE: NOVEMBER 12, 2019
DRAWING NO.: C–8	SHEET NO.: X OF XX		Weston Solutions, Inc. 1400 Weston Way West Chester, PA 19380

G:\Acadproj\20216001001 USACE JBMDL Sampling and Mitigation\C-8.dwg

APPENDIX B
COST ANALYSIS

APPENDIX B

COST ANALYSIS
WATER SUPPLY WELL DECOMMISSIONING AND REPLACEMENT
JOINT BASE MCGUIRE-DIX-LAKEHURST

COSTS	IX SYSTEM	DECOMMISSION/REPLACE
Capital Costs		
Install IX System	**$927,000**	
Install Replacement Well (Deep)		**$4,155,795**
Planning/Labor		$470,000
Site Work (Survey, utilities)		$20,795
Well Installation		$1,485,000
Treatment Building Installation		$1,150,000
Well Testing (Pump and water quality)		$845,000
Well & Treatment System Commissioning		$10,000
Shallow Well Decommissioning		$75,000
Demolish Existing Treatment Building		$100,000
Annual Operational Costs	**$290,000**	**$0**
Staffing	$20,000	
Sampling	$21,600	
Building Heat and Electrical	$40,000	
Media Change-out	$208,400	
Total Annual Operational Costs	**$290,000**	**$0**
Total Operational Present Value	**$5,684,128**	**$0**
Total Present Value	**$6,611,128**	**$4,155,795**