DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT CHIEF OF STAFF FOR INSTALLATION MANAGEMENT
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DAIM-ISE

SEP 04 2018

MEMORANDUM FOR

COMMANDER, ARMY MATERIEL COMMAND
DIRECTOR, NATIONAL GUARD BUREAU
COMMANDER, INSTALLATION MANAGEMENT COMMAND
CHIEF, U.S. ARMY RESERVE
CHIEF, BASE REALIGNMENT AND CLOSURE DIVISION

SUBJECT: Army Guidance for Addressing Releases of Per- and Polyfluoroalkyl Substances

1. References:

a. Memorandum, ASA(IE&E), 10 Jun 16, subject: Perfluorinated Compound (PFC) Contamination Assessment.

b. Memorandum, DASD(IE&E), 10 Jun 16, subject: Testing DoD Drinking Water for Perfluorooctane Sulfonate (PFOS) and Perfluorooctanoic Acid (PFOA).

c. Memorandum, DAIM-IS, 29 Aug 16, Department of Army Guidance to Address Perfluorooctane Sulfonate (PFOS) and Perfluorooctanoic Acid (PFOA) Contamination

d. Department of Defense Instruction 4715.18, Emerging Contaminants, 11 Jun 09.

e. Department of Defense Instruction 4715.07,Defense Environmental Restoration Program (DERP), 21 May 13.

f. Department of Defense Manual 4715.20, Defense Environmental Restoration Program (DERP) Management, 9 Mar 12.

g. Memorandum, ACSIM, 16 Apr 08, subject: Army Environmental Compliance-Related Cleanup Policy Guidance.

2. This guidance applies to Active Army installations, Base Realignment and Closure installations, Army National Guard facilities, and U.S. Army Reserve facilities, and provides a consistent framework for addressing historic releases of perflurooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), and any other per- and polyfluoroalkyl substances (PFAS) on Army Installations with Army and DoD approved regulatory standards or advisories applicable to Army facilities. It includes instructions for identifying the Army's inventory of sites where releases of PFAS may have occurred and for prioritizing sites for future investigations and response actions. It also includes guidelines for applying risk-based criteria during the cleanup process and requirements for sampling and analysis.

3. Further, this guidance applies to all Army-owned property. In cases where an environmental regulator, Federal Land Manager, or other stakeholder requests the Army to investigate known or suspected releases of PFAS on transferred property (e.g., BRAC and non-BRAC excess locations), the Army will evaluate the request on a site-specific basis. Such requests shall be sent through the chain of command, with input from the respective Staff Judge Advocate, to the Office of the Assistant Chief of Staff for Installation Management, Installation Services Directorate, Environmental Division (OACSIM Environmental Division) for resolution.

4. Due to the uncertainty in the regulatory and legal environment surrounding PFAS in general this guidance is subject to frequent updates.

5. My point of contact for this action is Mr. Malcolm Garg, (571) 256-9709 or malcolm.j.garg.civ@mail.mil.

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Army Guidance for Addressing Releases of Per- and Polyfluoroalkyl Substances (PFAS)

September 2018

1. REFERENCES:

a. Memorandum, ASA(IE&E), 10 Jun 16, subject: Perfluorinated Compound (PFC) Contamination Assessment.

b. Memorandum, DASD(IE&E), 10 Jun 16, subject: Testing DoD Drinking Water for Perfluorooctane Sulfonate (PFOS) and Perfluorooctanoic Acid (PFOA).

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e. Department of Defense Instruction (DoDI) 4715.18, Emerging Contaminants, 11 Jun 09

f. Department of Defense Manual 4715.20 DERP Management, 9 Mar 12.

g. Memorandum, Assistant Chief of Staff for Installation Management, subject: Army Environmental Compliance-related Cleanup (CC) Policy Guidance, 16 Apr 08.

2. PURPOSE AND SCOPE:

This guidance applies to Active Army installations, Base Realignment and Closure installations, Army National Guard facilities, and U.S. Army Reserve (USAR) facilities when planning and implementing environmental response actions to address releases of per- and polyfluoroalkyl substances (PFAS) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980. While PFAS is not a CERCLA hazardous substance, it is a pollutant or contaminant, so CERCLA investigations and potential response actions may be required when a PFAS release presents an imminent and substantial threat to human health. PFAS is also not a hazardous substance under the Resource Conservation and Recovery Act (RCRA), so any installations and facilities subject to RCRA corrective action would still conduct any PFAS investigations under the Army's CERCLA authority.

3. BACKGROUND:

a. PFAS are a diverse group of compounds resistant to heat, water, and oil. For decades, they have been used in hundreds of industrial applications and consumer products such as carpeting, apparel, upholstery, food paper wrappings, fire-fighting foams, and metal plating. PFAS have been detected both in the environment and in the blood samples of the general U.S. population. These chemicals are persistent, and resist degradation in the environment. They also bioaccumulate, meaning that their concentration increases over time in the blood and organs. At high concentrations,

certain PFAS have been linked to adverse health effects in laboratory animals that may reflect associations between exposure to these chemicals to include health problems such as low birth weight, delayed puberty onset, elevated cholesterol levels, and reduced immunologic responses to vaccination. (Reference: https://www.epa.gov/chemical-research/research-and-polyfluoroalkyl-substances-pfas)

b. The suite of chemicals known as PFAS includes, but is not limited to, the following:

(1) perfluorooctanesulfonic acid (PFOS, CASRN 1763-23-1),
(2) perfluorooctanoic acid (PFOA, CASRN 335-67-1),
(3) perfluorobutanesulfonic acid (PFBS, CASRN 375-73-5),
(4) perfluorodecanoic acid (PFDA CASRN 83-89-6),
(5) perfluorododecanoic acid (PFDoA, CASRN 307-55-1),
(6) perfluoroheptanoic acid (PFHpA, CASRN 374-85-9),
(7) perfluorohexanesulfonic acid (PFHxS, CASRN 355-46-4),
(8) perfluorohexanoic acid (PFHxA, CASRN 307-24-4),
(9) perfluorononanoic acid (PFNA, CASRN 375-95-1),
(10) perfluorotetradecanoic acid (PFTA, CASRN 376-06-7),
(11) perfluorotridecanoic acid (PFTrDA, CASRN 72629-94-68),
(12) perfluoround ecanoic acid (PFUnA, CASRN 2058-94-8),
(13) perfluorodecane sulfonate (PFDS, CASRN 335-77-3)
(14) perfluorobutanoic acid (PFBA, CASRN 375-22-4)
(15) perfluorooctane sulfonamide (PFOSA, CASRN 754-91-6)
(16) perfluoropentanoic acid (PFPeA, CASRN 2706-90-3)
(17) n-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA, CASRN 2991-50-6),
(18) n-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA, CASRN 2355-31-9).

c. In May 2016, the U.S. Environmental Protection Agency (EPA) issued a Lifetime Health Advisory (LHA) for PFOS and PFOA, singly or combined, of 0.07 micrograms per liter (µg/L) or 70 nanograms per liter (ng/L) or 70 parts per trillion (ppt) in drinking water. In addition to the USEPA LHA, some states are issuing regulatory standards of their own in multiple media, not just for PFOS and PFOA but other PFAS as well.

d. At Army installations, the primary mechanism for releases of PFAS is through the historic use (post-1972) of Aqueous Film Forming Foam (AFFF), a product applied during firefighting and firefighting-related training. AFFF for firefighting was, and is, generally used in areas where fuel- or petroleum-based fires may have occurred; such as in the vicinity of aviation assets, fuel farms, or aircraft crash sites. The Army's current practice is not to use AFFF for petroleum-based training fires. Other known sources of environmental releases of PFAS include mist suppressants for chrome plating operations and landfills and wastewater treatment plants that have inadvertently accepted PFAS containing materials.

4. STRATEGY:

The Army has begun conducting historical records reviews to identify locations where there is a potential for a release of PFAS. Locations on Army installations with the greatest likelihood of releases of PFAS include fire training areas, AFFF storage locations, aircraft crash sites, fuel farms and sites associated with aviation assets. The Army will assess and investigate potential releases and implement necessary response actions in accordance with CERCLA to ensure that there are no human health-based exposures above the CERCLA risk-based values or the LHA in drinking water. Response actions at sites meeting eligibility requirements per DoD Manual 4715.20 may be implemented using Defense Environmental Restoration Program (DERP) funding; all activities determined to be ineligible for DERP funding will be investigated under the Compliance-related Cleanup (CC) Program.

5. INVENTORY AND PRIORITIZATION:

a. The Army shall review and identify potential sites where PFAS releases may have occurred. Consistent with the DoD's "worst first" approach, potential PFAS release sites will be prioritized and sequenced along with other DERP or CC sites for further action based on risk, with higher risk sites being addressed before lower risk sites, in consideration of other factors. Sites where human exposure to contaminated drinking water exists will be addressed first and as quickly as possible (e.g., treatment at the distribution point, such as well head treatment, or by providing bottled water under a Time-Critical Removal Action) to eliminate the exposure, and will be subsequently prioritized and sequenced to conduct the investigations and response actions necessary to characterize and, if necessary, remediate the source of PFAS contamination.

Potential Army locations where releases of PFAS may have occurred and which merit evaluation include:

- Current or former fire training areas (FTAs) where AFFF is known or suspected to have been applied, including sites at Response Complete (RC) after completion of CERCLA response actions to address contaminants other than PFAS (e.g., petroleum hydrocarbons and semi-volatile organic compounds).

- Current or former AFFF storage locations.

- Aircraft crash sites where AFFF may have been applied for fire control.

- Aviation hangars and other buildings where AFFF is or was used in the fire suppression system and where a release may have occurred.

- Plating facilities that may have used PFAS-containing mist suppressants.

- Landfills where PFAS-containing materials may have been disposed.

- Wastewater treatment plants that may have received wastewater from facilities that used or disposed of PFAS-containing liquid effluents.

b. All installations or facility environmental offices (or equivalent) are required to provide all PFAS drinking water sampling data to Army Public Health Center (APHC) so PFAS results can be entered into the DOEHRS database. Additionally, all installation and facility environmental offices (or equivalent) will maintain an inventory of drinking water wells where PFAS associated with past Army activities was detected. The Army has completed the testing of all Army-owned drinking water systems, to include single wells.

6. INVESTIGATIVE PROCESS:

The Army will conduct historical research of potential PFAS source areas and determine whether there is a CERCLA release requiring a response action. Initially, Preliminary Assessments (PAs) will be conducted at installations where AFFF or other PFAS-containing materials were used or stored as part of operational history based on the prioritization process described in Section 5. Site Inspections (SI) will be conducted at sites where the PA identifies locations where further investigation is warranted to determine whether or not a release has occurred. If the SI indicates a release has occurred, a Remedial Investigation (RI) will be conducted to quantify the nature and extent of contamination; in some cases, an “expanded Site Inspection” may be appropriate and will be a site-specific decision. As noted in Section 5 sites will be prioritized and sequenced for further action along with other sites in the DERP or CC inventory based on risk, with higher risk sites being addressed before lower risk sites after considering potential exposure routes. For example, SIs for sites where no human drinking water exposure is expected may potentially be delayed to allow investigation of sites with the potential for human drinking water exposure. Similarly, RIs will be prioritized to focus on those facilities where the SI indicates human drinking water exposure is confirmed.

The PA shall be conducted on an installation-wide or facility-wide basis. If the site is determined to be DERP eligible, PFAS investigations or response actions may be funded through the Environmental Restoration, Army (ER,A) account. PA funding for DERP eligible sites will be reported as Program Management costs for end of year reporting. Project costs for newly identified sites will be tracked at the site level in Headquarters Army Environmental System (HQAES) once a SI phase or subsequent phase is deemed necessary. In addition to entering the necessary SI data to HQAES, a PA phase shall be added for each site using the start and end dates for the installation-wide PA.

PFAS investigations for sites that are not DERP eligible shall be conducted under the CC program with funding from the Operations and Maintenance, Army (OMA) account, Operations and Maintenance, National Guard (OMNG), or Operations and

Maintenance, Army Reserve (OMAR) account, as appropriate. CC sites requiring a SI will be added to HQAES and where appropriate, identify the need for future phases. If a new site requires CERCLA investigations or response actions beyond the SI phase, a cost-to-complete (CTC) estimate shall be prepared in accordance with the Army's FY17 CTC Guidance.

If additional investigation is required for a site where a response action has already occurred and the site is considered RC, an investigation phase for the site will be reopened, retaining the current site name and number in HQAES. In most cases, the site will be reopened at the SI phase; however, there may be instances in which sufficient data exists to move directly to an RI. The HQAES phase status for any post-investigation phase will be changed to "underway" to reflect the previous work conducted at the site. If PFAS were not considered to be constituents of concern (COCs) previously, but the PA determines that investigations are necessary for sites with ongoing investigations (e.g., SI or RI phases) or sites with ongoing response actions (e.g., RA-C or RA-O phase), the additional work shall be recorded in the current open HQAES phase. If an SI is required for a new site, the new site will be added to HQAES and included in the DERP or CC inventory.

7. EVALUATING HAZARDS AND TAKING ACTION:

a. The EPA established a reference dose (RfD) for both PFOA and PFOS of 0.02 µg/kg/day or 20 ng/kg/day. This equates to a Drinking Water Equivalent Level (DWEL) of 370 ng/L or 370 ppt for both PFOA and PFOS based on a lactating woman drinking water intake per day per body weight of 0.054 L/day/Kg (approximately three liters per day for a 60 kilogram individual). The LHA further assumes that 80% of exposure is derived through exposure via sources other than drinking water (e.g., food and air), leaving 20% allowable for drinking water exposure; therefore, the LHA is established at 70 ng/l or 70 ppt (74 ppt, rounded to 70 ppt). Further, the EPA determined that because the health effects for both PFOS and PFOA are similar the LHA of 70 ppt would combine (sum) both compounds.

b. The CERCLA process uses the RfD to determine non-carcinogenic hazard. In the case of PFOA and PFOS, the RfDs are equivalent. When assessing the hazard not associated with human drinking water exposure, the individual RfDs will be used (equates to 370 ppt in water) and will not be combined. When evaluating hazard against human drinking water exposure, the LHA of 70 ppt will be used and PFOS and PFOA concentrations will be combined. Currently, PFBS is the only other PFAS with a toxicity value meeting the requirements of Ref 1.d for CERCLA risk assessments. - Evaluating risks or hazards for PFAS other than PFOS and PFOA will be conducted in accordance with Ref 1.d.

c. It should be noted that the EPA also established a cancer oral slope factor (OSF) for PFOA, however the non-carcinogenic RfD led to a lower DWEL and therefore the RfD was used as a basis for the LHA. For PFOS, EPA determined that the evidence did not support the development of a cancer OSF.

d. Some states have issued their own standards for individual PFAS chemicals, while others have similar actions underway that are still working through the legislative and/or regulatory process. State promulgated PFAS standards reviewed and approved by DoD will be considered Applicable or Relevant and Appropriate Requirements (ARARs) during the Army's CERCLA investigations and actions; however, many states and/or regulatory bodies have non-promulgated health advisories (HAs) or similar. While the DoD and Army are acting on EPA's LHA of 70 ppt for combined PFOS/PFOA for drinking water and have committed to using the CERCLA process to address any releases, non-promulgated, non-enforceable state standards will not be considered ARARs. Requests for an exception should be submitted through the chain of command, with input from the respective Staff Judge Advocate, to the Office of the Assistant Chief of Staff for Installation Management, Installation Services Directorate, Environmental Division (OACSIM Environmental Division); if the exception is approved, these criteria will be classified as "to be considered" (TBC) values in the ARARs analysis.

e. If an environmental regulator requests PFAS sampling as part of a CERCLA response action at sites where the operational history does not suggest that PFAS-containing materials were used or stored, the issue should be elevated through the chain of command, to OACSIM Environmental Division for resolution.

f. Currently there is no guidance or obligation to assess for ecological risk; however, the human health risk from ingestion of fish, livestock, and plants; as well as water and soil, should be considered in accordance with Ref 1.d.

8. ANALYTICAL METHODS:

Drinking water analysis for PFAS shall only be performed using DoD Environmental Laboratory Accreditation Program (ELAP) accredited laboratories and shall use EPA Method 537, Rev. 1.1. All PFAS analytes that are available through this method should be reported. EPA Method 537, Rev. 1.1 currently includes 14 analytes; in the event that additional analytes are added to EPA Method 537 in the future, the new analytes shall be reported going forward if determined to be constituents of concern on a site-specific basis. Any additional PFAS analyte determined to be a site-specific constituent of concern should also be added to the list of compounds the laboratory is requested to report. All compounds to be reported should be on the laboratory's ELAP scope of accreditation.

Analysis for all other matrices (i.e., groundwater, surface water, soil, and sediment) shall be performed by an ELAP accredited laboratory using a liquid chromatography tandem mass spectrometry (LC/MS/MS) method that is on the laboratory's ELAP scope of accreditation and is compliant with the requirements in the DoD Quality Systems Manual (QSM) for Environmental Laboratories (the QSM version to which the laboratory is currently accredited (e.g., QSM version 5.1.1, Table B-15)). All PFAS analytes that are on the laboratory's ELAP scope of accreditation should be reported and must

include at least the analytes listed in EPA 537. Additional analytes that are added to EPA Method 537 in the future shall be reported going forward if determined to be site-specific constituents of concern. Any additional PFAS analyte determined to be a site-specific constituent of concern should also be added to the list of compounds the laboratory is requested to report. All compounds to be reported should be on the laboratory's ELAP scope of accreditation.

It should be noted that PFAS analysis is improving and method revisions, or new methods, are likely to come into existence in the near future. In all cases, the laboratory must be ELAP accredited, have the method and reported analytes on the laboratory's ELAP scope of accreditation, and be in compliance with the version of the DoD QSM to which the laboratory is accredited.

DoD Environmental Laboratory Accreditation Program (ELAP) accredited labs for PFAS (PFC) analysis may be found at:
https://www.denix.osd.mil/edqw/accreditation/accreditedlabs

9. INVESTIGATION-DERIVED WASTE (IDW):

Waste containing PFAS is not classified as a characteristic or listed hazardous waste based solely on the presence of PFAS chemicals; however, given the potential for future liability, it is recommended that project teams design investigations to minimize generation of IDW.

Solid IDW may be disposed as non-hazardous solid waste. Investigators should clearly note the presence of PFAS on waste manifests for full disclosure of contents. For liquid IDW (e.g., purge water), a sample shall be analyzed using EPA Method 537 (Modified) prior to disposal. If the combined concentration of PFOS/PFOA is less than 70 ppt, and assuming that no other contamination is present and no state or local regulation prohibits it, the water may be discharged to the sanitary sewer after disclosing the nature and concentrations of PFAS constituents contained in the liquid IDW to the local wastewater authority and after obtaining a recordable authorization from the authority. Liquid IDW with a combined PFOS/PFOA concentration greater than 70 ppt shall be held pending written authorization by the facility director of the treatment plant that will receive the liquid. If no treatment facility is available then disposing liquid IDW as liquid non-hazardous waste at an EPA approved Subtitle-D Industrial Waste Landfill or equivalent facility capable of processing liquid non-hazardous waste should be considered; written authorization and acceptance of the PFAS containing IDW should be obtained from the landfill. Additionally, treatment of liquid IDW to bring the waste to acceptable disposal levels may be conducted.

APPENDIX A

Frequently Asked Questions (FAQs) for Army Programs

(These FAQs are not intended to be used for public affairs)

General/Definitions

Q1. What are emerging contaminants (ECs)?
A1. There is no single, consensus definition of ECs across agencies; different organizations (e.g., DoD, EPA, state agencies) have differing definitions of ECs, and thus, possibly different chemicals identified as ECs.

DoD defines an EC as: (1) Has a reasonably possible pathway to enter the environment; (2) Presents a potential unacceptable human health or environmental risk; and (3) Does not have regulatory standards based on peer-reviewed science, or the regulatory standards are evolving due to new science, detection capabilities, or pathways. (https://www.denix.osd.mil/cmrmp/ecmr/ecprogrambasics/)

EPA's definition is: "An 'emerging contaminant' is a chemical or material that is characterized by a perceived, potential or real threat to human health or the environment or by a lack of published health standards." (EPA 2014a)

Q2. Is it reasonable to assume that PFAS will be present at my site?
A2. If the conceptual site model (CSM) suggests that AFFF was released into the environment, it is likely that a variety of PFAS will be present at the site. Because PFAS is widely used throughout much of the world, varying levels of PFAS are anticipated. At DoD facilities, one of the primary sources of environmental PFAS will be areas where AFFF was used for activities related to firefighting (e.g., fire training areas, runways, crash sites, hangars, fuel farms, where fires or accidental releases of AFFF occurred, equipment testing and washout areas, oil-water separators or other piping systems where released AFFF may have flowed). Sludge in oil-water separators at hangars and sludge from sewage treatment at Army flight lines could potentially contain PFAS.

AFFF is the name on the Military Specification (MIL-SPEC) for the firefighting foam commonly used for hydrocarbon (e.g., fuel) and electrical fires; however, fluorinated foams by any name should be noted in the investigations and their ingredients identified, if known.

Additionally, PFAS were sometimes included in mist suppressants which may have been used in plating baths for hard chrome plating. Low concentrations of PFAS have also been identified in effluent from wastewater treatment plants and in landfill leachate. The historical research aspect of the installation-wide investigation should identify any source of PFAS.

Q3. What are the similarities and differences between AFFF formulations that I need to know about for my site?

A3. AFFF formulations used at DoD facilities differ in their chemical composition. Each formulation is comprised of various individual PFAS at varying individual concentrations. Formulations used at DoD facilities are listed on the Qualified Products List (QPL). To be listed on the QPL, formulations must meet the requirements of the DoD MIL-SPEC for AFFF. Every formulation listed on the QPL must be compatible with all other formulations that are currently listed on the QPL. This allows for the mixing of different formulations without introducing performance issues. Because of this, vessels such as firefighting vehicles containing a formulation were not typically drained and cleaned prior to introducing a different formulation. In addition, some formulations contained such high concentrations of some PFAS that conventional cleaning protocols would not eliminate them. As a result, the determination of potential for release of a particular PFAS should be partially based on AFFF usage, not usage of a particular AFFF formulation.

Eligibility and Funding

Q4. Are PFAS considered Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) contaminants?
A4. PFAS, including PFOA and PFOS, are not listed as CERCLA hazardous substances and therefore have not historically been included in typical CERCLA/DERP environmental investigations. Though not a CERCLA hazardous substance, PFAS are considered a CERCLA pollutant or contaminant.

PFAS fall within the definition of ECs contained in DoD Instruction 4715.18, and can be included in a DERP investigation if a reasonable basis exists to suspect a release may have occurred.

Q5. Can ER,A or BRAC funding be used to investigate and remediate PFAS?
A5. If the CSM indicates the use or release of AFFF or other industrial activities for which PFAS are associated, then ER,A, BRAC or CC funds can be used to investigate, and if necessary, perform restoration of media impacted by PFAS. However, ER,A or BRAC funds can only be used to address past releases of PFAS; ER,A or BRAC funds cannot be used to investigate/remediate potential ongoing releases at active operations or at non-DERP eligible sites.

As with any EC, it can be challenging to reach concurrence on the potential risk and/or cleanup levels for contaminants with limited toxicity information, such as PFAS (see Risk Assessment section). Therefore, RPMs will coordinate within the environmental chain of command and the appropriate Offices of Counsel before agreeing to cleanup levels to ensure the most current scientific/technical information is being appropriately considered.

Q6. What if the site has achieved Response in Place (RIP), Response Complete (RC) or Site Closure (SC)?
A6. If a site has already been investigated and achieved RIP, RC or SC, then any additional investigation should only be initiated after careful consideration, with

adequate justification, and with concurrence from the respective ER Manager (for ER,A) or Base Environmental Coordinator (for BRAC). Existing sites will be re-opened in lieu of adding a new site (refer to the OSD re-opener policy memorandum, *Revised Site Management*, 22 Aug 2016). Installations will send a Memorandum for Record (MFR) to Headquarters, Department of the Army (HQDA) to notify of re-opened sites. In situations where the Army is not in control of the property (i.e., a transferred property) and is requested to investigate for PFAS the issue will be brought up to HQDA through the chain-of-command and will be resolved on a site specific basis. To consider sampling a site for PFAS, the CSM must be well understood and strongly suggest there is reason to believe these chemicals have impacted environmental media in areas where exposure can occur.

Sampling and Analysis

Q7. Are there special sampling techniques for these chemicals?
A7. Yes, special sampling techniques should be used. PFAS are a class of manufactured compounds that are extensively used in a variety of industrial and commercial products to make items more resistant to stains, grease and water. Some of these products could be present and/or used during a routine sampling event, such as plastic bags and bottles, waterproof clothing, detergents and waterproof pens and paper. The use of any of these products could contaminate the samples during sample collection. This includes what is used to prepare the sampling site, what is used to collect the sample, what is used to clean the sampling equipment, what the sample is collected in and how the sample is shipped.

Several precautions should be taken during sample collection to avoid inadvertent sample contamination:

- Post It Notes® should not be used at any time during sample handling, or mobilization/demobilization.
- Personnel involved with sample collection and handling should avoid wearing new clothing (e.g., at least six washings since purchase; no softening agents used during washing/drying).
- Personnel involved with sample collection and handling should not wear water resistant clothing or shoes/boots immediately prior to or during sample collection.
- Personnel involved with sample collection and handling should not wear Tyvek® suits.
- Personnel involved with sample collection and handling should wear nitrile gloves at all times while collecting and handling samples.
- Many food and snack products are packaged in wrappers treated with PFAS. Therefore, hands will be thoroughly washed after handling fast food, carryout food or snacks.
- Pre-wrapped food or snacks (like candy bars, microwave popcorn, etc.) must not be in the possession of sampling personnel during sampling or handling for shipping.
- Blue Ice® must not be used to cool samples or used in sample coolers.
- Products containing Teflon®-containing materials should be avoided (e.g.,

tubing, bailers, tape and plumbing paste). In cases where Teflon®-containing materials are unavoidable, ensure adequate purging is performed prior to sampling (e.g., in-well pumps) and/or collect rinse blanks prior to sampling.

Sample bottles should be obtained from the laboratory performing the analysis. DoD ELAP-accredited laboratories are required to ensure the sample bottles provided to clients have been verified as clean (meet the acceptance criteria for blanks for analysis). Drinking water samples must be collected in accordance with EPA Method 537. EPA Method 537 requires drinking water samples to be collected in polypropylene bottles with a polypropylene screw cap. All other samples must be collected in a high-density polyethylene (HDPE) container with an unlined plastic screw cap.

More information on sampling can be found in the DoD Environmental Data Quality Workgroup (EDQW) PFAS Sampling-Fact Sheet, Rev. 1.2, November 2016. (http://www.denix.osd.mil/edqw/home/)

Q8. What analytical method should be used for drinking water samples?
A8. Drinking water samples must be analyzed by EPA Method 537, which currently lists 14 perfluoroalkyl acids, including PFOS and PFOA.

Q9. What analytical methods are currently available for other media?
A9. There currently are no published EPA methods for media other than drinking water. DoD ELAP laboratories have modified EPA Method 537 for the other media (i.e., groundwater, surface water, sediment, soil) and expanded the analyte list to include other PFAS. These modified methods are the methods that are currently recommended for all matrices other than drinking water. DoD ELAP requirements for these modified methods can be found in the DoD Quality Systems Manual (QSM), Version 5.1.1, Appendix B, Table B-15. A copy of the DoD QSM, Version 5.1.1 can be found under the heading "What's New" on the EDQW page on the DENIX website: http://www.denix.osd.mi1/edqw/home/.

Total Oxidizable Precursor (TOP) assay: In addition to the compounds being analyzed consideration should be given to polyfluorinated compounds or ‘precursor’ compounds that can biotransform into end-state perfluoroalkyyl acids (PFAAs) like PFOS and PFOA. Such ‘precursor’ compounds can often explain a detection of PFOS/PFOA where no source is known. A new method, the TOP assay, can help measure the concentration of difficult to measure PFAS compounds that are not determined by conventional analytical methods. The TOP method is relatively expensive when compared to the current conventional analytical methodology and should be used sparingly during a remedial investigation (RI) stage or, when a detection cannot be adequately explained with a source/pathway.

Particle Induced Gamma Ray Emission (PIGE): PIGE analysis can be useful during the remedial design phase to determine total mass loading for different technologies (e.g., GAC treatment), and is also available for field lab analysis that can be used for

delineation purposes similar to FID/PID readings used for high resolution site characterization (HRSC) direct push units.

Q10. Are there any DoD ELAP-accredited laboratories that can perform PFAS analysis?

A10. Yes, there are DoD ELAP-accredited laboratories that can provide EPA Method 537 and modified EPA Method 537. A list of DoD ELAP accredited laboratories can be found on DENIX at: https://www.denix.osd.mil/edqw/accreditation/accreditedlabs. A list of DoD ELAP laboratories that are currently accredited to perform analysis of drinking water samples by EPA Method 537 can be generated by performing a method search for "EPA 537." A list of DoD ELAP laboratories that are currently accredited to perform analysis of other media in accordance with the requirements of DoD QSM Version 5.1.1 can be generated by performing a method search for "PFAS by LCMSMS Compliant with QSM 5.1.1 Table B-15".

The DENIX database should be used as a starting point when selecting a laboratory for a project. It does not provide all information needed (e.g., analyte lists for methods). To ensure the laboratory you select is accredited for your project analytes, the project manager/chemist must review the laboratory's scope of accreditation, which is found on their accreditation body's website.

The DoD ELAP accredited laboratory database can be found by following the link under the heading "Search Accredited Labs" on the EDQW page on the DENIX website: http://www.denix.osd.mil/edqw/home/ or at https://www.denix.osd.mil/edqw/accreditation/accreditedlabs

Q11. Is there a difference between how aqueous samples (not including drinking water samples) are prepared and analyzed when the sample contains a high concentration of PFAS, versus low concentrations of PFAS?

A11. Yes, samples containing a high concentration of PFAS, such as AFFF formulations, must be prepared by serial dilution using an aliquot of the sample received and analyzed by direct injection of the serial dilution. Each sample is required to be prepared and analyzed in this manner in duplicate; therefore, two analytical results are reported for each sample.

Preparation of samples not containing high concentrations of PFAS utilizes the entire sample that was collected in the field. The entire sample is extracted using a solid phase extraction process and an aliquot of the extract is analyzed. No duplicate is performed in laboratory analysis on these samples.

To determine which category a sample falls into, laboratories screen each sample. In order to not affect the final result of low concentration samples, it is recommended that a smaller bottle (e.g., 75-125 mL versus 250 mL) be collected for screening purposes alongside the routine sample volumes in the field. If samples are collected that are known to contain high concentrations of PFAS, this should be clearly noted on the chain of custody (CoC) that is sent with the samples to the laboratory.

Requirements for both processes are included in the DoD QSM, Version 5.1.1, Appendix B, Table B-15.

Q12. Is there a standard target analyte list for PFAS investigations?
A12. For drinking water analysis, yes. Method 537, Rev 1.1 currently includes the following 14 compounds:

- N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)
- N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)
- Perfluorobutanesulfonic acid (PFBS)
- Perfluorodecanoic acid (PFDA)
- Perfluorododecanoic acid (PFDoA)
- Perfluoroheptanoic acid (PFHpA)
- Perfluorohexanesulfonic acid (PFHxS)
- Perfluorohexanoic acid (PFHxA)
- Perfluorononanoic acid (PFNA)
- Perfluorooctanesulfonic acid (PFOS)
- Perfluorooctanoic acid (PFOA)
- Perfluorotetradecanoic acid (PFTA)
- Perfluorotridecanoic acid (PFTrDA)
- Perfluoround ecanoic acid (PFUnA)

When drinking water is analyzed, results for these compounds should be reported by the laboratory.

Since currently there is no "standard" laboratory method for matrices other than drinking water, laboratories have made modifications to Method 537, Rev. 1.1 to address other media such as soil, groundwater and sediment. These modifications are not standardized among laboratories and therefore, neither are the lists of analytes that are detected. Currently laboratories using modified Method 537, Rev. 1.1 may analyze for 14 to 30 compounds. The Army is currently collecting 18 PFAS compounds (listed in Section 3b, p.3) for its PA/SI effort.

The Army's direction is to apply the LHA to actual drinking water sampling to identify the need for further evaluation. Other media, such as groundwater and soil, should be addressed on a site-specific basis; however, to avoid delays in receipt of results used to assess current exposure, it is recommended that only those PFAS with EPA derived toxicity values (i.e., currently PFOA, PFOS and PFBS) be requested for expedited turn-around time and expedited data validation. Since the other compounds are not being used to make decisions, receipt of those data do not need to be expedited. ·Data evaluation, validation and site management decisions should be based on the DQOs for the site, which should include only the analytes with toxicity values. All other PFAS analytes should be placed in an appendix of the report.

Investigation

Q13. What should an installation-wide PA/SI include?
A13. An installation-wide PA/SI should identify all areas on the installations where AFFF is or was stored, used, released, disposed, etc. Unfortunately, historical documentation of AFFF use and releases is often incomplete because records were not required; therefore, in addition to document reviews, interviews will be crucial to understanding past practices and identifying the potential for environmental releases. The installation fire department should be contacted to determine if the installation currently or historically used AFFF, and to identify locations where it has been used (e.g., training, crashes, etc.). Coordination with the Water Program Media Managers, Spill Program Managers, and the regional Army On-Scene Coordinators (AOSC) will also provide information on AFFF releases/spills. AFFF that was stored or released at installations may have migrated to the subsurface; therefore, potential PFAS-impacted soil or sediment may be an ongoing source for PFAS impacts to groundwater and/or surface water.

Although AFFF is considered the primary source of PFAS at Army installations, PFAS are also found in a variety of other materials/processes, including chromium plating bath mist suppressant, wastewater treatment plant biosolids/effluent, sludge drying beds and landfill leachate.

Identification of sites will be based on the review of existing information about use and disposal practices at the installation and may include limited field data to determine the nature of any releases and potential threat to receptors. Consideration should be given to: 1) areas where firefighting exercises were conducted; 2) areas where fire suppression infrastructure exists or existed (e.g., fire stations, AFFF equipment storage areas and former pump houses); 3) unplanned release areas such as crash sites, equipment cleaning discharge locations, fire suppression systems located at fuel storage areas, also at installation sites where large fires occurred (e.g., large warehouse fires, etc.); 4) areas where chromium electroplating operations were performed; 5) landfill and waste disposal areas receiving waste streams containing PFAS; 6) areas where waste material and sludge from wastewater treatment plants was disposed

To evaluate the threat to human receptors, the PA/SI should include information on groundwater gradients, topographic maps, locations of drinking water wells and maps illustrating the relative positions of potential sites to drinking water wells.

Q14. What should be expected regarding fate and transport of PFAS?
A14. Current sampling results indicate that the highest groundwater concentrations will likely be found near the source area and diminish with distance. Preliminary research data suggest that individual PFAS may differ in their affinity for each matrix as well as their rates of migration from a source. Although PFAS are very water soluble, some PFAS have been found in soils at FTAs that have been closed for years.

Because of the potential of numerous anthropogenic PFAS background sources it is recommended to have a thorough background sampling regimen to be able to differentiate between background PFAS and PFAS releases emanating from an Army facility.

Polyfluorinated compounds or 'precursor' compounds found in AFFF can be biotransformed into end-state perfluoroalkyyl acids (PFAAs) (PFOA in particular) as a result of oxidation. This can result in PFOA/PFOS concentrations in areas not easily described through a source/pathway interaction if 'precursors' are not evaluated.

Due to the emerging status and complex chemistries, a clear picture of environmental fate and transport is not available at this time. In an effort to begin answering some of these questions, DoD has funded several Strategic Environmental Research and Development (SERDP) and Environmental Security, Testing, and Certification Program (ESTCP) projects related to this topic.

Q15. What if PFAS may have reached a drinking water source?
A15. If, during an investigation, a potential for drinking water exposure to any on- or off-installation human receptor is identified, the installation should immediately: 1) notify the command chain, up to and including HQDA; 2) gain approval to initiate appropriate notifications; 3) implement drinking water sampling of affected properties and 4) have a drinking water distribution contingency plan in place (i.e., bottled water).

The Army Environmental Command in coordination with Army Public Health Center is the repository for all DA-approved notification/communication resources regarding this issue, to include notification templates and fact sheets developed specifically for potentially affected populations. This office can be reached by calling 210-466-1590 and by email to usarmy.jbsa.aec.mbx@mail.mil.

If PFOA and/or PFOS are confirmed in drinking water above the EPA LHAs, immediate actions must be taken to notify affected individuals and reduce/eliminate the exposure. For immediate response, this typically involves providing alternate (e.g., bottled) water for drinking, cooking and any consumption, until a long-term solution is implemented.

If drinking water wells have been impacted, but do not have levels of PFOA and/or PFOS above the EPA LHA, then a site-specific decision needs to be made regarding continued monitoring until a long-term solution is implemented. Consideration should be given to the Army's facility monitoring schedule for when the PFOS/PFOA level is detected above the method reporting limit but below the LHA sampling will occur quarterly for one year and once every two years thereafter.

Currently DoD is only addressing PFOS and PFOA. Some states are beginning the process to regulate other PFAS in water (both drinking water and/or groundwater). If PFAS other than PFOS and PFOA are affecting a drinking water purveyor the issue should be elevated through the chain of command to ACSIM-ISE for resolution.

Restoration activities evaluating risks or hazards for PFAS other than PFOS and PFOA will be conducted in accordance with Ref 1.d (4715.18, Emerging Contaminants).

Q16. What if a release is suspected to have migrated offsite?
A17. If the CSM indicates that a historical release may have migrated offsite, then sampling may need to be initiated offsite to identify nature and extent and potential complete exposures. The most significant concern is the potential impact that offsite migration would have on drinking water wells in the vicinity. In this instance, ER Managers (for ER,A) or Base Environmental Coordinator (for BRAC), the installation's chain of command, and HQDA should be notified and sampling should be expedited if potentially complete exposures are expected. Coordination with legal, real estate, and possibly regulators will be needed to gain right of entry access agreements to private properties. The nature and extent of the off-site sampling will be site-specific and will depend on the CSM, sample results, concentration of off-site wells and other site-specific considerations. If drinking water is potentially affected the actions listed in paragraph 1 of A15 should be followed.

Q17. Should a PFAS investigation be carried out at a site where foam was used but there are no records supporting that the foam formulation contained PFAS?
A17. Yes, for the following reasons: 1) Current understanding is that any AFFF formulations on the QPL may include perfluoroalkyl substances like PFOA; 2) AFFF formulations likely also contain polyfluoroalkyl substances, some of which have the potential to degrade into the perfluoroalkyl substances, including PFOA; 3) the polyfluoroalkyl substances may possess toxicity; and 4) the equipment used to deliver AFFF may still contain small amounts of older product from previous refills. Reported uses of "protein foam" were typically "fluoroprotein foam" which contained other fluorinated surfactants, including PFOS. Given the different formulations used, it is recommended that PFAS investigations should also include sites that only report uses of "protein foam" or "fluoroprotein foam".

Q18. How should investigation-derived waste (IDW) at PFAS sites be disposed?
A18. Environmental investigations at potential PFAS sites will generate IDW. Waste containing PFAS is not classified as a characteristic or listed hazardous waste based solely on the presence of PFAS chemicals. However, given the potential future liability, it is recommended that project teams design investigations to minimize IDW generation.

Solid IDW may be disposed as non-hazardous solid waste. Investigators should clearly note the presence of PFAS on waste manifests for full disclosure of contents. For liquid IDW (e.g., purge water), a sample shall be analyzed using EPA Method 537 (Modified) prior to disposal. If the combined concentration of PFOS/PFOA is less than 70 ppt, and assuming no other contamination is present and no state or local regulation prohibits it, the water may be disposed to the sanitary sewer without additional special handling after disclosing the nature and concentrations of PFAS constituents contained in the liquid IDW to the local wastewater authority and after obtaining a recordable authorization from the authority. Liquid IDW with a combined PFOS/PFOA

concentration greater than 70 ppt shall be held pending written authorization by the facility director of the treatment plant that will receive the liquid.

If it is expected that the concentrations of PFOA and PFOS will be much higher than 70 ppt (e.g., captured residual from an accidental release in a hangar), special actions may be needed to dispose of the waste-stream. These instances should be brought to the attention of HQDA and the installation's chain of command for coordination with the appropriate program (e.g., compliance). The most current technical considerations, limitations and options will be provided for consideration.

If the PFAS containing IDW cannot be disposed then treatment of the IDW should be considered. Presently there are number of viable treatments; skid mounted GAC units, ion exchange resin treatment, reverse osmosis, Advanced Oxidation Processes, etc. New treatment technologies are being made available. The efficacy of the treatment technology should be considered.

Risk Assessment

Q19. Should PFAS automatically be included in the risk assessment?
A19. PFAS should only be sampled for if the CSM suggests the potential for a historical release of these chemicals. If the CSM supports environmental sampling for PFAS, then these sampling results should be considered to make remedial decisions. For the majority of sites, this will include a quantitative risk assessment; however, it should be noted in the uncertainty section that Tier 2 and/or 3 toxicity values would be used for these ECs.

Q20. What human health risk assessment screening levels are available?
A20. As always, screening levels may be developed through partnering relationships between the RPM and regulatory agencies. Ordinarily, the EPA Regional Screening Level (RSL) tables would be a good place to start; however, the most recent version of the RSL table (June 2017) does not include PFOA and PFOS.

On 15 November 2016, the EPA Office of Water released a memorandum that clarified that the Health Advisories developed in May 2016 were only to be applied to drinking water. The Health Advisories (HAs) are based on toxicity values derived in documents that specifically target exposure via drinking water; not dermal contact or inhalation. EPA also stated that the Health Advisories are not applicable in identifying risk levels for ingestion of food. The EPA memo did not specifically address ingestion of non-food solids such as soil or indicate if this restriction extends to the toxicity values upon which the LHAs are based. It should be noted that while PFOS and PFOA both have HAs, PFBS does not.

Until EPA guidance is provided, cleanup teams should discuss the level of confidence they would assign to screening levels based on the EPA Office of Water's toxicity values. When those RfDs are used with the current (June 2017) RSL calculations and

default assumptions, the possible screening levels are provided on the table below. Note that since these toxicity values are not listed in the current (June 2017) RSL table, they are not to be considered vetted Tier 3 toxicity values as described in EPA directive (2003).

Screening Level Scenario	Groundwater (µg/L)			Soil (mg/kg)		
	PFOA[1]	PFOS[1]	PFBS[2]	PFOA[1]	PFOS[1]	PFBS[2]
Residential exposure	0.4	0.4	380	1.3	1.3	1,600
Industrial worker exposure	NA	NA	NA	16	16	23,000

1. Values are calculated for PFOA and PFOS using the EPA's on-line RSL calculator in June 2017 and are based on a target hazard quotient of 1.
2. Values are from the EPA Regional Screening Level table, June 2017.
NA means that currently these values are not applicable.

Q21. What human health toxicity values are available?
A21. Currently there are no toxicity values for any PFAS available from a Tier 1 (i.e., EPA's Integrated Risk Information System (IRIS)) source.

Non-cancer toxicity values are currently available for PFOA and PFOS for the ingestion route of exposure (i.e., RfDs) (references n and o). Note that as of June 2017, EPA has not confirmed that these are Tier 3 values. Although Tier 3 toxicity values are appropriate for use in CERCLA Human Health Risk Assessments (HHRAs) per EPA (EPA 2003), there is always increased uncertainty associated with the use of Tier 3 toxicity values since their level of peer review and acceptance in the scientific community are not as rigorous as for Tier 1 and Tier 2 toxicity values. As such, if CERCLA cleanup levels are being derived, RPMs should discuss this with their respective ER Manager.

The chronic non-cancer RfDs for both PFOA and PFOS is 2 x 10^{-05} mg/kg-day (20 ng/kg-day). For both chemicals, this value is based on developmental effects. The EPA Office of Water also estimated a CSF for oral exposure to PFOA of 0.07 mg/kg-day.

A Tier 2 (i.e., EPA's Provisional Peer-Reviewed Toxicity Value (PPRTV)) oral reference dose is available for PFBS (EPA 2014). The chronic Tier 2 non-cancer RfD for PFBS is 0.02 mg/kg-day. This is based on kidney effects in a subchronic rat study. EPA also established a Tier 2 subchronic RfD of 0.2 mg/kg-day based on kidney effects in a rat study. EPA is currently reevaluatiing PFBS toxicity, as such, any actions related to PFBS should take into account the latest findings.

Q22. What exposure pathways should be included in a human health risk assessment?
A22. For PFOA, PFOS, and PFBS, the only toxicity values available are for ingestion. As such, if the CSM supports it, the ingestion exposure route can be estimated for human health. On 15 November 2016, the EPA Office of Water issued a memorandum that clarified the LHA in drinking water cannot be used to identify risk levels for ingestion of food sources (EPA 2016d). The EPA did not clarify if the toxicity values used to develop the LHA can be applied to incidental ingestion of soil, such as is reflected in the EPA RSL for both residential and industrial contact with soil. However, the toxicity values developed by the EPA Office of Water are included in the online RSL calculator. This inconsistency has not been explained by EPA so an explanation is not available for this document. At this time, there is uncertainty regarding the appropriateness of using those Tier 3 RfDs for incidental ingestion of soil.

Q23. Should we still use the EPA's 2009 Short-term Provisional Health Advisory levels and/or the toxicity values generated in 2009 for PFOA and PFOS?
A23. No. When EPA finalized the health advisory documents for both PFOA and PFOS (references n and o), the EPA considered these values to supersede the previous short-term provisional health advisory levels of 2009. Since the 2016 LHA levels are based in part on developmental effects, EPA considers the LHA levels to also be protective for short-term exposure. If the 2009 values were used previously to establish remedial goals, the goals may need to be reevaluated to ensure overall protection of human health, which is a threshold criteria for evaluating remedial alternatives under the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

Q24. Do PFAS need to be considered in the ecological risk assessment?
A24. Yes, if the CSM includes complete exposure pathways for ecological receptors and there are accepted screening values provided in accordance with the EPA Ecological Risk Assessment Guidance for Superfund (ERAGS). Currently no ecological risk guidance is available but it should be noted that there may be a human health risk from ingestion of media such as fish, livestock or plants; in addition to water and soil.

Q25. What ecological risk assessment screening levels are available?
A25. Many scientific papers have been published that begin establishing potential values for ecotoxicity of some PFAS. If regulators provide or recommend ecological screening levels for any PFAS, it is recommended to check with an Army ecological risk assessor to vet those values.

<u>Applicable or Relevant and Appropriate Requirements (ARARs) and/or To-Be-Considered (TBC) Values</u>

Q26. Are there federal ARARs or TBCs for any PFAS?
A26. At this time, no federal ARARs have been identified for PFAS. The EPA's LHAs for PFOA and PFOS are not ARARs, because the LHAs are not promulgated, enforceable standards. The LHAs can be used either as TBCs, or as measures of

protectiveness. If the LHAs are identified as TBCs, they will have the effect of an ARAR when finalized in a decision document (DD); however, if the LHAs are cited in establishing a risk-based level for the protection of human health, they do not have the effect of an ARAR. Consequently, risk-based protective levels are more flexible than ARARs or TBCs.

References

a. Department of Defense Instruction (DoDI) 4715.18, Emerging Contaminants, 11 June 2009.

b. Memorandum, Office of the Assistant Secretary of Defense (OASD) for Energy, Installations and Environment, 10 June 2016, subject: Testing DoD Drinking Water for Perfluorooctane Sulfonate (PFOS) and Perfluorooctanoic Acid (PFOA).

c. Memorandum, OASD, 9 March 2012, subject: Revised Site Management procedures – Update to DoD Manual 4715.20, Defense Environmental Restoration Program Management.

d. Memorandum, Headquarters, Department of the Army (HQDA), Assistant Secretary of the Army for Installations, Energy and Environment (ASA IE&E), 10 June 2016, subject: Perfluorinated Compound (PFC) Contamination Assessment.

e. Memorandum, HQDA ACSIM, 29 August 2016, subject: Department of the Army Guidance to Address Perfluorooctane Sulfonate and Perfluorooctanoic Acid Contamination.

f. Memorandum, HQDA ACSIM, 21 June 2017, subject: Supplemental Drinking Water Monitoring Guidance for Perfluorooctane Sulfonate and Perfluorooctanoic Acid.

g. APHC Technical Information Paper No. 85-067-0117, 2017, Environmental Criteria Perfluorinated Alkyl Compounds.

h. APHC Chemical and Material Emerging Risk Alert, undated, Aqueous Film Forming Foam (AFFF).

i. EPA Office of Solid Waste and Emergency Response (OSWER) Directive 9355.0-30, 1991, Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions.

j. EPA OSWER Directive 9285.7-53, 5 Dec 2003, Human Health Toxicity Values in Superfund Risk Assessments.

k. EPA OSWER 9285.7- 02EP, July 2004, Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), EPA/540/R/99/005.

l. EPA OSWER, 28 October 2009, The Toxicity of Perfluorooctanoic Acid (PFOA) and Perfluorooctane Sulfonate (PFOS).

m. EPA Fact Sheet, March 2014, Emerging Contaminants - Perfluorooctane Sulfonate (PFOS) and Perfluorooctanoic Acid (PFOA),

(http://www2.epa.gov/sites/production/files/2014-04/documents/factsheet_contaminant/_pfos_pfoa_march2014.pdf).

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

o. EPA Office of Water, May 2016, Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS).

p. EPA Technical Advisory, 2016. Laboratory Analysis of Drinking Water Samples for Perfluorooctanoic Acid (PFOA) Using EPA Method 537 Rev. 1.1.

q. EPA Office of Water, 15 November 2016, 2016. Clarification about the Appropriate Application of the PFOA and PFOS Drinking Water Health Advisories.

r. EDQW Fact Sheet, October 2016, Bottle Selection and other Sampling Considerations When Sampling for Per- and Poly-Fluoroalkyl Substances (PFASs)

Useful Web Sites

https://army.deps.mil/army/cmds/imcom_USAEC/AEC/Emerging_Contaminants/Forms/AllItems.aspx?InitialTabId=Ribbon%2ERead&VisibilityContext=WSSTabPersistence#InplviewHash9309b17e-e1a0-46a0-bea5-5671276d1df7

https://www.epa.gov/pfas

http://pfas-1.itrcweb.org/

https://www.serdp-estcp.org/News-and-Events/Blog/Advances-in-Perfluoroalkyl-Chemicals-PFCs-Characterization-and-Remediation

https://www.serdp-estcp.org/Featured-Initiatives/Per-and-Polyfluoroalkyl-Substances-PFASs

http://www.awwa.org/portals/0/files/legreg/documents/awwapfcfactsheettreatmentandremoval.pdf

APPENDIX B

ACRONYMNS

ACSIM	Army Chief of Staff for Installation Management
AFFF	Aqueous Film Forming Foam
APHC	Army Public Health Center
ARAR	Applicable or Relevant and Appropriate Requirement
ARNG	Army National Guard
BRAC	Base Realignment and Closure
CC	Compliance Related Cleanup
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CoC	Constituents of Concern
CSM	Conceptual Site Model
CTC	Cost-To-Complete
DD	Decision Document
DENIX	DoD Environment, Safety and Occupational Health Network and Information Exchange
DERP	Defense Environmental Restoration Program
DERP	Defense Environmental Restoration Program
DoDI	Department of Defense Instruction
DoDM	Department of Defense Manual
DOEHRS	Defense Occupational Environmental and Health Readiness System
DWEL	Drinking Water Equivalent Level
EC	Emerging Contaminant
EDQW	Environmental Data Quality Workgroup
ELAP	Environmental Laboratory Accreditation Program
EPA	Environmental Protection Agency
ER,A	Environmental Restoration, Army
ESTCP	Environmental Security, Testing, and Certification Program
FAQs	Frequently Asked Questions
FID	Flame Ionization Detector
FTA	Fire Training Area
HA	Health Advisory
HDPE	High-Density Polyethylene
HQAES	Headquarters Army Environmental System
HRSC	High Resolution Site Characterization
IDW	Investigation Derived Waste
IRIS	Integrated Risk Information System
LC/MS/MS	Liquid Chromatography (LC) Tandem Mass Spectrometry (MS)
LHA	Lifetime Health Advisory
MIL-SPEC	Military Specification
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
OACSIM	Office of Army Chief of Staff for Installation Management
OMA	Operations and Maintenance, Army

OMAR	Operations and Maintenance, Army Reserve
OMNG	Operations and Maintenance, National Guard
OSF	Oral Slope Factor
PA	Preliminary Assessment
PFAAS	Perfluoroalkyyl Acids
PFAS	Per- and polyfluoroalkyl substances
PFBS	Perfluorobutane Sulfonate
PFC	Perfluorinated Compound
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctane Sulfonate
PID	Photo-Ionization Detector
PIGE	Particle Induced Gamma Ray Emission
QPL	Qualified Products List
QSM	DoD Quality Systems Manual
RA-C	Remedial Action Construction
RA-O	Remedial Action Operation
RC	Response Complete
RCRA	Resource Conservation and Recovery Act
RfD	Reference Dose
RIP	Response in Place
RPM	Restoration Project Manager
RSL	Regional Screening Level
SC	Site Closure
SERDP	Strategic Environmental Research and Development
SI	Site Inspections
TBC	To Be Considered
TOP	Total Oxidizable Precursor
USAR	U.S. Army Reserve