Uploaded to the VFC Website

2018

This Document has been provided to you courtesy of Veterans-For-Change!

Feel free to pass to any veteran who might be able to use this information!

For thousands more files like this and hundreds of links to useful information, and hundreds of "Frequently Asked Questions, please go to:

Veterans-For-Change

If Veterans don't help Veterans, who will?

Note: VFC is not liable for source information in this document, it is merely provided as a courtesy to our members & subscribers.

	A	B	C	D	E	F	G	H	I
1	**Base**	**Location**	**Service (primary)**	**On-base drinking water contamination?**	**Off-base drinking water contamination?**	**Other water supply contamination?**	**Money spent on investigations**	**Money spent on clean-up**	**Total money spent**
2	Eielson Air Force Base	Alaska	Air Force	Yes	Yes		$920,800	$8,734,000	$9,654,800
3	March Air Force Base	California	Air Force		Yes		$1,364,000	$1,000	$1,365,000
4	Mather Air Force Base	California	Air Force			Yes	$1,571,000	$197,000	$1,768,000
5	Fort Hunter Liggett	California	Army	Yes			$0	$0	$0
6	Naval Support Activity Monterey	California	Navy	Yes			N/A	N/A	N/A
7	Camp Pendleton (South)	California	USMC	Yes			$0	$0	$0
8	Peterson Air Force Base	Colorado	Air Force		Yes		$1,303,700	$4,127,700	$5,431,400
9	Dover Air Force Base	Delaware	Air Force		Yes		$541,200	$27,500	$568,700
10	New Castle Air National Guard	Delaware	Air Force			Yes	$103,700	$0	$103,700
11	Naval Support Facility Diego Garcia - Cantonment/Air Operations	Diego Garcia	Navy	Yes			N/A	N/A	N/A
12	Naval Support Facility Diego Garcia - I Site	Diego Garcia	Navy	Yes			N/A	N/A	N/A
13	Naval Support Facility Diego Garcia - Sub Site	Diego Garcia	Navy	Yes			N/A	N/A	N/A
14	Soto Cano Air Base	Honduras	Army	Yes			N/A	N/A	N/A
15	Mountain Home Air Force Base	Idaho	Air Force	Yes			$790,700	$0	$790,700
16	Chanute Air Force Base	Illinois	Air Force			Yes	$2,805,000	$360,000	$3,165,000
17	Fort Leavenworth	Kansas	Army	Yes			$0	$0	$0
18	U.S. Army Garrison Daegu - Camp Carroll	Korea	Army	Yes			N/A	N/A	N/A
19	U.S. Army Garrison Daegu - Camp Walker	Korea	Army	Yes			N/A	N/A	N/A
20	U.S. Army Red Cloud-Camp Red Cloud	Korea	Army	Yes			N/A	N/A	N/A
21	U.S. Army Red Cloud-Camp Stanley	Korea	Army	Yes			N/A	N/A	N/A
22	Barnes Air National Guard	Massachusetts	Air Force			Yes	$9,100	$0	$9,100
23	Joint Base Cape Cod	Massachusetts	Air Force		Yes		$1,317,600	$305,500	$1,623,100
24	K.I. Sawyer Air Force Base	Michigan	Air Force		Yes		$2,395,000	$0	$2,395,000
25	Wurtsmith Air Force Base	Michigan	Air Force		Yes		$2,079,700	$3,000,000	$5,079,700
26	New Boston Air Force Station	New Hampshire	Air Force	Yes			$8,900	$0	$8,900
27	Pease Air Force Base	New Hampshire	Air Force		Yes		$12,500,000	$4,000,000	$16,500,000
28	Joint Base McGuire-Dix-Lakehurst	New Jersey	Air Force		Yes		$617,300	$1,187,000	$1,804,300
29	Naval Weapons Station Earle	New Jersey	Navy		Yes		$786,000	$59,000	$845,000
30	Plattsburgh Air Force Base	New York	Air Force		Yes		$2,042,000	$30,000	$2,072,000
31	Stewart Air National Guard	New York	Air Force			Yes	$163,700	$0	$163,700
32	Gabreski Air National Guard	New York	Air Force		Yes		$199,700	$0	$199,700
33	Toledo Air National Guard	Ohio	Air Force		Yes		$151,700	$0	$151,700
34	Wright-Patterson Air Force Base	Ohio	Air Force	Yes	Yes		$503,300	$2,805,600	$3,308,900
35	Horsham Air Guard Station	Pennsylvania	Air Force	Yes	Yes		$127,000	$6,300,000	$6,427,000
36	NASJRB Willow Grove	Pennsylvania	Navy		Yes		$4,065,000	$10,862,000	$14,927,000
37	Naval Air Warfare Center Warminster	Pennsylvania	Navy		Yes		$3,218,000	$12,966,000	$16,184,000
38	Ellsworth Air Force Base	South Dakota	Air Force		Yes		$587,600	$1,706,900	$2,294,500
39	Joe Foss Field	South Dakota	Air Force			Yes	$151,700	$0	$151,700
40	Burlington Air National Guard	Vermont	Air Force			Yes	$107,900	$0	$107,900
41	Naval Auxiliary Landing Field Fentress	Virginia	Navy	Yes	Yes		$2,706,000	$96,500	$2,802,500
42	Fairchild Air Force Base	Washington	Air Force		Yes		$790,000	$0	$790,000
43	Joint Base Lewis-McChord, Fort Lewis Cantonment*	Washington	Army	Yes			$10,000	$0	$10,000
44	Joint Base Lewis-McChord, McChord Field*	Washington	Army	Yes			$10,000	$0	$10,000
45	Naval Air Station Whidbey Island	Washington	Navy		Yes		$1,284,000	$90,000	$1,374,000
46	Martinsburg Air National Guard	West Virginia	Air Force			Yes	$127,700	$0	$127,700
47									
48	* Records list $20,000 total for Joint Base Lewis McChord, but not for which site. We split it between the two.								

THE UNDER SECRETARY OF DEFENSE
3010 DEFENSE PENTAGON
WASHINGTON, DC 20301-3010

ACQUISITION,
TECHNOLOGY,
AND LOGISTICS

OCT 16 2017

The Honorable William M. "Mac" Thornberry
Chairman
Committee on Armed Services
U.S. House of Representatives
Washington, DC 20515

Dear Mr. Chairman:

Pursuant to the Joint Explanatory Statement accompanying the Consolidated Appropriations Act of 2017 (Public Law 115-31), enclosed is the Aqueous Film Forming Foam (AFFF) Report to Congress. This report provides information regarding the Department of Defense's efforts to address elevated levels of perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) on military bases and in neighboring communities due to the use of AFFF.

This report assesses the number of formerly used and current military installations where AFFF was, or is currently, used and the impact of elevated levels of PFOS and PFOA in drinking water on surrounding communities. The report also includes plans for prompt community notification of elevated PFOS and PFOA levels when detected, and the procedures for timely remediation. An identical letter has been sent to the other congressional defense committees.

Sincerely,

Ellen M. Lord

Enclosure:
As stated

cc:
The Honorable Adam Smith
Ranking Member

THE UNDER SECRETARY OF DEFENSE
3010 DEFENSE PENTAGON
WASHINGTON, DC 20301-3010

ACQUISITION,
TECHNOLOGY,
AND LOGISTICS

OCT 16 2017

The Honorable John McCain
Chairman
Committee on Armed Services
United States Senate
Washington, DC 20510

Dear Mr. Chairman:

Pursuant to the Joint Explanatory Statement accompanying the Consolidated Appropriations Act of 2017 (Public Law 115-31), enclosed is the Aqueous Film Forming Foam (AFFF) Report to Congress. This report provides information regarding the Department of Defense's efforts to address elevated levels of perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) on military bases and in neighboring communities due to the use of AFFF.

This report assesses the number of formerly used and current military installations where AFFF was, or is currently, used and the impact of elevated levels of PFOS and PFOA in drinking water on surrounding communities. The report also includes plans for prompt community notification of elevated PFOS and PFOA levels when detected, and the procedures for timely remediation. An identical letter has been sent to the other congressional defense committees.

Sincerely,

Ellen M. Lord

Enclosure:
As stated

cc:
The Honorable Jack Reed
Ranking Member

THE UNDER SECRETARY OF DEFENSE
3010 DEFENSE PENTAGON
WASHINGTON, DC 20301-3010

ACQUISITION,
TECHNOLOGY,
AND LOGISTICS

OCT 16 2017

The Honorable Thad Cochran
Chairman
Subcommittee on Defense
Committee on Appropriations
United States Senate
Washington, DC 20510

Dear Mr. Chairman:

Pursuant to the Joint Explanatory Statement accompanying the Consolidated Appropriations Act of 2017 (Public Law 115-31), enclosed is the Aqueous Film Forming Foam (AFFF) Report to Congress. This report provides information regarding the Department of Defense's efforts to address elevated levels of perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) on military bases and in neighboring communities due to the use of AFFF.

This report assesses the number of formerly used and current military installations where AFFF was, or is currently, used and the impact of elevated levels of PFOS and PFOA in drinking water on surrounding communities. The report also includes plans for prompt community notification of elevated PFOS and PFOA levels when detected, and the procedures for timely remediation. An identical letter has been sent to the other congressional defense committees.

Sincerely,

Ellen M. Lord

Enclosure:
As stated

cc:
The Honorable Richard J. Durbin
Vice Chairman

THE UNDER SECRETARY OF DEFENSE
3010 DEFENSE PENTAGON
WASHINGTON, DC 20301-3010

ACQUISITION,
TECHNOLOGY,
AND LOGISTICS

OCT 16 2017

The Honorable Kay Granger
Chairwoman
Subcommittee on Defense
Committee on Appropriations
U.S. House of Representatives
Washington, DC 20515

Dear Madam Chairwoman:

Pursuant to the Joint Explanatory Statement accompanying the Consolidated Appropriations Act of 2017 (Public Law 115-31), enclosed is the Aqueous Film Forming Foam (AFFF) Report to Congress. This report provides information regarding the Department of Defense's efforts to address elevated levels of perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) on military bases and in neighboring communities due to the use of AFFF.

This report assesses the number of formerly used and current military installations where AFFF was, or is currently, used and the impact of elevated levels of PFOS and PFOA in drinking water on surrounding communities. The report also includes plans for prompt community notification of elevated PFOS and PFOA levels when detected, and the procedures for timely remediation. An identical letter has been sent to the other congressional defense committees.

Sincerely,

Ellen M. Lord

Enclosure:
As stated

cc:
The Honorable Peter J. Visclosky
Ranking Member

Aqueous Film Forming Foam

Report to Congress

October 2017

Office of the Under Secretary of Defense
for Acquisition, Technology, and Logistics

The estimated cost of this report or study for the Department of Defense is approximately $11,000 for the 2017 Fiscal Year. This includes $3,600 in expenses and $7,200 in DoD labor.
Cost estimate generated on August 10, 2017 RefID: C-88F-50EC

Table of Contents

Appendices

I. Introduction

The Joint Explanatory Statement accompanying the Consolidated Appropriations Act, 2017 (Public Law 115-31), directs the Secretary of Defense to provide information regarding the Department's efforts to address perfluorinated chemicals (PFCs) contamination on military bases and in neighboring communities due to the use of aqueous film forming foam (AFFF). This report contains information to meet the following reporting requirements:

1. Assess the number of formerly used and current military installations where AFFF was or is currently used, and the impact of PFC contaminated drinking water on surrounding communities; and

2. Include plans for prompt community notification of such contamination, when the contamination was detected, and the procedures for timely remediation.

II. Background

PFCs, including perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA), are a large group of man-made chemicals commonly found in the environment. PFCs are widely used to make many industrial and consumer products resistant to heat, stains, water, and grease (e.g., non-stick cookware, waterproof fabric, and firefighting foam). In the 1970s, DoD began using AFFF that contained PFOS and, in some formulations, PFOA. This mission critical product saves lives and protects assets by quickly extinguishing petroleum-based fires, and the Federal Aviation Administration required its use at airports nationally. As a result of AFFF use, PFOS and PFOA has been detected at a number of DoD installations. This report focuses on PFOS and PFOA because these are the only known PFCs with health advisories.

In May 2000, the American manufacturers began voluntarily phasing out the production of PFOS-related products, including AFFF containing PFOS, in response to proposed U.S. Environmental Protection Agency (EPA) regulations under the Toxic Substances Control Act. Shortly after that time, AFFF containing PFOS was no longer available for purchase, but due to its long shelf life the DoD Components may still have some AFFF containing PFOS in their inventory.

In 2009, the EPA Office of Water established a provisional short-term health advisory for PFOS at 200 parts per trillion (ppt) and PFOA at 400 ppt under the Safe Drinking Water Act (SDWA). Although this advisory applied only to drinking water and not to cleanup, DoD used the toxicity data from the provisional health advisory to assess risk to human health at its cleanup sites. Using the 2009 provisional health advisory, DoD identified very few sites that posed an unacceptable risk to human health.

To address rising concerns associated with the use of AFFF containing PFOS, DoD issued a human health and environmental risk alert for AFFF in 2011 that suggested guidelines to control future releases. The alert also advised the DoD Components to determine site-specific characterization, assessment, and risk management procedures if records indicate that a facility may have a release of AFFF into the environment.

On May 19, 2016, EPA issued a SDWA lifetime health advisory (LHA) recommending that the individual or combined levels of PFOS and PFOA concentrations in drinking water be below 70 ppt. This LHA level is significantly lower than the 2009 short-term health advisory. While it is only guidance under the SWDA and is not a required or enforceable drinking water standard, DoD began taking actions to address impacted drinking water based on the new LHA. For example, DoD issued a policy in June 2016 requiring the DoD Components to sample and test drinking water systems where DoD is the water purveyor and to take action where the EPA LHA was exceeded.

The DoD Components also developed strategies under the Defense Environmental Restoration Program (DERP) to start proactively investigating and addressing DoD releases of PFOS and PFOA. As of December 31, 2016, DoD has spent approximately $202 million on PFOS and PFOA sampling, analysis, and cleanup, including about $199 million that was originally programmed for cleanup activities at other sites. This will likely lead to delays in completing cleanup at those sites. We also expect the cost-to-complete estimate to increase as we determine what cleanup actions are required to address the releases of PFOS and PFOA.

III. DoD's Approach to PFOS and PFOA

The Department is committed to addressing the health risk associated with releases of PFOS and PFOA and ensuring safe drinking water for the people living and working on its installations and in the surrounding communities. To that end, DoD is using a multi-faceted approach, discussed in more detail below, to address PFOS and PFOA concerns related to drinking water, cleanup, and the AFFF supply chain.

Drinking Water on Our Installations

The Department sampled 63 drinking water systems for PFOS and PFOA in compliance with EPA's SDWA 3rd Unregulated Contaminant Monitoring Rule (UCMR3)[1]. After the Department completed UCMR3 testing in December 2015, only one DoD drinking water system, at Wright Patterson Air Force Base, tested above the EPA LHA level. The Air Force took the two affected wells at Wright Patterson Air Force Base out of service and worked with Ohio environmental officials to install granular activated carbon filters on the impacted wells. These wells have since returned to service.

In June 2016, the Assistant Secretary of Defense for Energy, Installations, and Environment (ASD(EI&E)) directed the DoD Components to test for PFOS and PFOA where DoD supplies drinking water, including overseas systems, and assess the results against the EPA LHA level. Under this policy, as of March 2017, DoD has tested 83 percent of its 515 drinking water systems and expects to complete the testing in FY 2017. Appendix A shows the number of installations and drinking water systems the DoD Components tested. As of December 2016, 19

[1] UCMR3 required sampling of approximately 6,000 public drinking water systems in the United States and its territories between 2013 and 2015, including 63 DoD drinking water systems. The estimate of 6,000 public drinking water systems is based on the May 2012 EPA UCMR3 fact sheet, "The Third Unregulated Contaminant Monitoring Rule: Searching for Emerging Contaminants in Drinking Water."

DoD drinking water systems, including overseas, tested above the EPA LHA level. For drinking water systems that test above the EPA LHA level, DoD is following EPA's health advisory recommended actions. Appendix B lists the 19 drinking water systems that tested above the EPA LHA level, and includes the EPA recommended actions the DoD Components took to ensure no one is drinking water with elevated levels of PFOS and/or PFOA. These actions include, but are not limited to:

- Publicly notifying water consumers;
- Shutting down a well(s);
- Retesting;
- Providing alternative drinking water; and
- Adding a granular activated carbon filter to the well.

Additionally, where DoD purchases drinking water, installations are encouraged to ask if their suppliers have tested the drinking water for PFOS and PFOA and if so, whether the results are below the EPA LHA level. If the drinking water supplier has not conducted testing, the Departments of the Air Force and Navy test the drinking water at the tap. The Department of the Army is in the early stages of testing. If the results of these tests are above the EPA LHA level, DoD Components will work with the drinking water supplier to take appropriate actions.

DERP

The Department is committed to addressing on-base releases and off-base migration of PFOS and PFOA under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The Department follows a comprehensive approach to identify installations where DoD used AFFF containing PFOS or PFOA. The Department then determines whether there is exposure through drinking water and, if there is exposure, the Department's priority is to cut off the drinking water exposure. The Department will prioritize sites with a known or suspected release of PFOS or PFOA for investigation and cleanup, if necessary, using a risk-based approach. The Department's fundamental premise in site prioritization is "worst first," meaning the DoD Components will address sites that pose a relatively greater potential risk to human health or the environment before sites posing a lesser risk. The Department's priority is to quickly reduce significantly elevated levels of PFOS and PFOA in drinking water. DoD Components will take appropriate actions under CERCLA to address the health risk associated with DoD releases of PFOS and PFOA. This is discussed in more detail in the "Formerly Used and Current Military Installations Where AFFF Was or Is Currently Used and the Impact of PFOS and PFOA Contaminated Drinking Water on Surrounding Communities" section of this report.

AFFF Replacement

DoD Components are working to remove AFFF containing PFOS and PFOA from the supply chain. In January 2016, ASD(EI&E) issued a policy requiring the DoD Components to: 1) issue Military Service-specific risk management procedures to prevent uncontrolled land-based releases of AFFF during maintenance, testing, and training activities and 2) remove and properly dispose of AFFF containing PFOS from the local stored supplies for non-shipboard use to prevent future environmental response action costs, where practical. Under this policy, the Air Force funded the removal of AFFF from all fire trucks and crash response vehicles, and

replaced it with environmentally preferable PFOS-free AFFF containing only trace quantities of PFOA. All Air Force bases except Thule Air Force Base, Greenland, have received replacement AFFF and 97 percent of the bases have completed the transition. In addition, the Navy is updating the Military Specification requirements for AFFF, and working with manufacturers to determine the exact chemical composition of AFFF alternatives.

The Department is also investing in research and development projects to develop a fluorine-free foam. For example, DoD has partnered with the National Toxicology Program of the National Institute of Environmental Health Sciences, which is evaluating the toxicity of AFFF compounds on the DoD qualified products list. The purpose of this evaluation is to assist DoD in making decisions about selecting and procuring the qualified fluorinated products with the highest performance and lowest toxicity.

IV. Formerly Used and Current Military Installations Where AFFF Was or Is Currently Used and the Impact of PFOS and PFOA Contaminated Drinking Water on Surrounding Communities

The Department followed a comprehensive approach to identify installations where DoD used AFFF containing PFOS or PFOA. Releases of PFOS and PFOA on DoD installations are primarily associated with firefighting training areas, hangars, fire suppression systems, and aircraft crash sites. As of December 31, 2016, DoD has identified 393 active and Base Realignment and Closure installations with one or more areas where there is a known or suspected release of PFOS and/or PFOA; Appendix C lists these installations and the associated investigation and cleanup costs, where applicable. This list includes sites that DoD is currently addressing as part of its DERP, and new areas not currently included in the DERP (e.g., airplane crash sites, aircraft hangar suppression systems). These known or suspected PFOS and PFOA release areas are in various stages of assessment, investigation, and cleanup.

Now that DoD has an initial list of known and suspected release areas, DoD Components are following the CERCLA process to investigate these releases to confirm if a release occurred. The DoD Components will collect information on the nature and extent of the releases to determine if cleanup actions are necessary. The Department considers the EPA's health advisory information when addressing risk to human health under its cleanup program consistent with EPA risk assessment guidance.

The Department is following the EPA advisory recommendations for off-base migration into drinking water, and will notify the appropriate state agencies and affected communities. The Department investigates the source(s) of the PFOS and PFOA to reduce the risk associated with drinking water above the LHA in a timely manner and minimize the impact of PFOS and PFOA to surrounding communities. For example, after detecting PFOS above the EPA provisional health advisory level in drinking water samples at the former Pease Air Force Base in April 2014, the Air Force promptly notified the New Hampshire Department of Environmental Services of the elevated levels. In response, the City of Portsmouth immediately shut down the affected wells, and the Air Force began investigating the source of the PFOS and PFOA in the groundwater and in off-site private water supply wells.

V. Plans for Prompt Community Notification of Drinking Water Contamination, When Contamination was Detected, and Procedures for Timely Remediation

Throughout the cleanup process, DoD works in concert with regulatory agencies and communities, and shares information in an open and transparent manner. When elevated levels of PFOS and PFOA are detected that may pose an unacceptable risk to human health, DoD uses a proactive outreach strategy to promptly notify potentially affected community members. Outreach efforts may include:

- Communicating proactively to potentially affected communities;
- Partnering with local regulatory and governmental organizations to reach stakeholders;
- Hosting public meetings;
- Alerting and engaging with the media;
- Messaging through community social media; and
- Updating community leaders.

The DoD Components use a variety of methods to actively reach out to and notify the surrounding community about the potential impacts of PFOS and PFOA. For example, the Air Force established a proactive outreach program to provide potentially affected communities with consistent and accurate information regarding its responses to PFOS and PFOA. The Air Force's community outreach efforts include participating in public community meetings (both ad hoc and Restoration Advisory Boards (RABs)[2]), providing local and social media alerts and engagement, updating community leaders and influencers, and posting pertinent information on the Air Force Civil Engineer Center (see http://www.afcec.af.mil/WhatWeDo/Environment/Perfluorinated-Compounds) and installation-specific public web sites. The Air Force also develops fact sheets to inform affected residents of the Air Force's efforts to prevent human exposure to PFOS and PFOA. Throughout the outreach process, the Air Force collaborates with local regulatory and governmental organizations to reach stakeholders.

Additionally, the Navy is developing frequently asked questions documents to help the public understand Navy-wide and installation-specific cases related to PFOS and PFOA contamination that may impact their communities. For example, the Navy prepared an off-base sampling fact sheet for Naval Air Station Fallon. The fact sheet informs the public of the potential exposure to PFOS and PFOA detected in the onsite groundwater. The fact sheet also explains the Navy's request to sample drinking water at a home in the surrounding community to determine if PFOS and PFOA are present in private drinking water wells in the area, and highlights the Navy's future actions based on the sampling results. These future actions include notifying the resident of his or her personal drinking water results and providing an alternate water source, if necessary, until the Navy can implement a permanent solution. For more information about the Navy's policies on and management strategy for addressing PFOS and PFOA, see http://www.secnav.navy.mil/eie/pages/pfc-pfas.aspx.

---

[2] The Department encourages community involvement in the cleanup process through RABs. Since 1994, DoD has established RABs at more than 300 military installations and properties in the United States and its territories to encourage communities and installation personnel to identify and discuss potential cleanup issues.

VI. Conclusion

Addressing elevated levels of PFOS and PFOA from DoD activities is a priority for DoD. The DoD Components have taken action to ensure safe drinking water for people living and working on their military installations and in the surrounding communities. Following the CERCLA process, DoD is addressing its cleanup responsibility and promptly notifying affected communities. DoD is also taking steps to remove and replace AFFF containing PFOS in the supply chain, and is committed to finding a fluorine-free alternative that safeguards its troops and military assets, meets critical mission requirements, and protects human health and the environment.

Department of Defense Aqueous Film Forming Foam Report to Congress

Appendix A

Number of Installations and Drinking Water Systems Tested for PFOS and PFOA, and Associated Sampling Costs

This Appendix provides the number of installations and drinking water systems DoD Components tested as of March 2017, and the associated costs.

Appendix A: Summary by DoD Component
Number of Installations and Drinking Water Systems Tested for Perfluorooctane Sulfonate (PFOS)/Perfluorooctanoic Acid (PFOA), and Associated Sampling Costs

DoD Component	Number of Installations in US/Territories/ Overseas[1,2]	Associated Drinking Water Systems[2]		Drinking Water Systems Tested by DoD or non-DoD Purveyor[2]		Drinking Water Systems Tested by DoD and Cost where PFOS/PFOA < EPA LHA Level[3]		Drinking Water Systems Tested by DoD and Cost where PFOS/PFOA > EPA LHA Level[6]		Total Drinking Water Sampling Costs[4,5] (thousands of dollars)
		DoD Purveyor	Non-DoD Purveyor	DoD Purveyor	Non-DoD Purveyor	Number of Systems[2]	Cost[4,5] (thousands of dollars)	Number of Systems[2]	Cost[4,5] (thousands of dollars)	
Army[7]	2,884	246	1,993	159	1,354	284	$1,411.4	9	$30.4	**$1,441.8**
Navy	108	100	236	100	236	151	$260.0	5	$388.6	**$648.6**
USMC	68	28	52	28	52	29	$47.5	1	$11.5	**$59.0**
Air Force	177	140	134	140	128	268	$213.0	5	$167.0	**$380.0**
DLA	8	1	7	1	7	5	$21.4	0	$0.0	**$21.4**
DoD Totals	**3,245**	**515**	**2,422**	**428**	**1,777**	**737**	**$1,953.2**	**20**	**$597.5**	**$2,550.7**

Footnotes:

1: Includes Guard and Reserve facilities.

2: The number of installations and the number of drinking water systems are current as of March 28, 2017.

3: The EPA Lifetime Health Advisory (LHA) level for PFOS and PFOA is 70 parts per trillion (individually or combined).

4: Cost data are current as of December 31, 2016.

5: This cost does not include in-house labor, public notifications, travel, or contractual actions.

6: The number of drinking water systems tested by DoD and the associated cost includes Fort Leavenworth, where the Army is not the drinking water purveyor.

7: The Army has contracted a portion of its drinking water system sampling and anticipates finalizing that sampling by the end of Fiscal Year 2017.

Department of Defense Aqueous Film Forming Foam Report to Congress

Appendix B

DoD Summary of Safe Drinking Water Actions where DoD is the Drinking Water Purveyor and the Systems Tested Above the EPA LHA Level

This Appendix provides a summary of actions taken by the DoD Components for drinking water systems where DoD is the drinking water purveyor and the systems tested above the EPA LHA level.

Appendix B: DoD Summary of Safe Drinking Water Actions where DoD is the Drinking Water Purveyor and the Systems Tested Above the EPA LHA Level

DoD Installations where DoD is the Drinking Water Purveyor and Actions Taken to Address PFOS/PFOA Above the EPA LHA Level[1]					
DoD Component	Installation	State	Results (PFOS/ PFOA) or Range	Actions Taken[2]	Total Cost through Dec 31, 2016[3,4] (thousands of dollars)
Army	Fort Hunter Liggett	California	330	Costs reported are for multiple rounds of sampling throughout the water system. One well at Fort Hunter Liggett exceeded the LHAs and has been taken offline. A treatment system will be installed on that well if it is needed in the future, to ensure the water is below the LHAs.	$2.1
Army	JB Lewis-McChord: Fort Lewis Cantonment	Washington	72	Costs reported are for multiple rounds of sampling throughout the water system. One well at the Lewis Cantonment area exceeded the LHAs and has been shut down. The remaining wells will be used to supply water until a treatment system can be installed to ensure the water from the system is below the LHAs.	$3.4
Army	JB Lewis-McChord: McChord Field	Washington	250	Costs reported are for multiple rounds of sampling throughout the water system. Two wells at the McChord Field area of JBLM exceeded the LHAs and have been shut down. The remaining wells will be used to supply water under the LHAs, and treatment systems will be installed to mitigate the two wells so they can be turned back on while ensuring the water distributed is below the LHAs.	$3.4
Army	Soto Cano AB, HN	Honduras	59-83	Costs reported are for multiple rounds of sampling throughout the water system. Two wells were above the LHAs initial sampling. No wells were above LHAs with confirmatory sampling. Bottled water is being used on the installation until additional confirmatory sampling confirms water is below the LHAs.	$2.8
Army	USAG Daegu, KR Camp Carroll	Korea	327	Costs reported are for multiple rounds of sampling throughout the water system. Camp Carroll's onsite water was above the LHAs and they isolated and shut down those wells over the LHAs so all water being distributed now is below the LHAs.	$3.8
Army	USAG Daegu, KR Camp Walker	Korea	244	Costs reported are for multiple rounds of sampling throughout the water system. Camp Walker's onsite water was above the LHAs and they have connected to the city water, which is below the LHAs.	$3.8
Army	USAG Red Cloud, KR: Camp Red Cloud	Korea	381	Costs reported are for multiple rounds of sampling throughout the water system. Camp Red Cloud's onsite water was above the LHAs and they have connected to the city water, which is below the LHAs.	$3.8
Army	USAG Red Cloud, KR: Camp Stanley	Korea	169	Costs reported are for multiple rounds of sampling throughout the water system. Camp Stanley's onsite water was above the LHAs and they have connected to the city water, which is below the LHAs.	$3.8
				Army Subtotal:	**$26.7**

Appendix B: DoD Summary of Safe Drinking Water Actions where DoD is the Drinking Water Purveyor and the Systems Tested Above the EPA LHA Level

DoD Installations where DoD is the Drinking Water Purveyor and Actions Taken to Address PFOS/PFOA Above the EPA LHA Level[1]					
DoD Component	Installation	State	Results (PFOS/ PFOA) or Range	Actions Taken[2]	Total Cost through Dec 31, 2016[3,4] (thousands of dollars)
Navy	NAS Oceana - NALF Fentress	Virginia	2,800-4,900	Drinking water sampling and analysis. Navy provided alternative drinking water, upgraded wastewater treatment plant, design/construction for water treatment plant	$364.0
Navy	NSA Monterey - Naval Radio Transmitter Facility Dixon	California	260	Drinking water sampling and analysis. Navy is providing alternative drinking water and retesting drinking water wells.	$0.8
Navy	NSF Diego Garcia: Cantonment/Air Operations	Diego Garcia	5,849	Alternate drinking water supply was already being provided due to other contaminants. New drinking water treatment plant MILCON project was completed in December 2016, which will address PFOS/PFOA.	$0.0
Navy	NSF Diego Garcia: I Site	Diego Garcia	102	Actions taken at the I Site are included in the actions taken at the Cantonment/Air Operations Site.	$0.0
Navy	NSF Diego Garcia: Sub Site	Diego Garcia	74-78	Shut down drinking water wells that exceeded EPA LHAs wells. Bottled water was being provided until granular activated carbon filters were replaced and reconfigured. Conducting quarterly retesting of drinking water wells.	$23.8
				Navy Subtotal:	**$388.6**
USMC	MCB Camp Pendleton (South)	California	77	-One sample exceeded the PFOS/PFOA combined Health Advisories Level. -The affected reservoir was drained and replaced with water from another source. -Resampling confirmed levels below the Health Advisories Level in the current water supply and levels slightly above the Health Advisories Level in the well taken out of service. Installation will continue to monitor the system.	$11.5
				USMC Subtotal:	**$11.5**

Appendix B: DoD Summary of Safe Drinking Water Actions where DoD is the Drinking Water Purveyor and the Systems Tested Above the EPA LHA Level

DoD Installations where DoD is the Drinking Water Purveyor and Actions Taken to Address PFOS/PFOA Above the EPA LHA Level[1]					
DoD Component	Installation	State	Results (PFOS/ PFOA) or Range	Actions Taken[2]	Total Cost through Dec 31, 2016[3,4] (thousands of dollars)
Air Force	Eielson AFB	Alaska	9-91	Drinking water sampling and analysis. Three out of six drinking water wells were taken off-line. Eielson upgraded the base water treatment plant by installing activated carbon filter. Eielson conducting monthly sampling.	$35.0
Air Force	Horsham Air Guard Station	Pennsylvania	PFOS: 60 PFOA: 290	Drinking water sampling and analysis for several years. Two drinking water wells are off-line. Currently sampling monthly at four locations.	$3.0
Air Force	Mountain Home Air Force Base	Idaho	77-105	Drinking water sampling and analysis. AF purchasing pallets of bottled water for consumption until mitigation actions can be completed. Additional sampling conducted to determine safe location for replacement drinking water well and to determine filtration system requirements for drinking water well #4.	$30.0
Air Force	New Boston	New Hampshire	13-78	Drinking water sampling and analysis. Well above the EPA LHAs has been shut down. The AF is conducting quarterly sampling for the operational drinking water wells.	$2.0
Air Force	Wright Patterson Air Force Base (AFB)	Ohio	90-235	Drinking water sampling and analysis. Bottled water was provided for Area A, where two drinking water wells and the treatment system were shut down. In the process of installing granular activated carbon filter system. Base officials are continuing to sample drinking water to ensure levels remain below the EPA LHAs.	$97.0
				Air Force Subtotal:	**$167.0**
				Grand Total:	**$593.8**

Footnotes:

1: The EPA Lifetime Health Advisory (LHA) level for PFOS and PFOA is 70 parts per trillion (individually or combined).

2: Examples of actions taken include but are not limited to: sampling and analysis, retesting, shutting down a well(s), providing alternative drinking water, adding an activated carbon filter to the well, blending water systems, etc.

3: Costs include but are not limited to sample collection, analysis and reporting plus any costs associated with the actions taken.

4: This cost does not include in-house labor, public notifications, travel, or contractual actions.

Department of Defense Aqueous Film Forming Foam Report to Congress

Appendix C

DoD Installations with a Known or Suspected Release of PFOS or PFOA

This Appendix provides the DoD installations with one or more known or suspected releases of PFOS or PFOA.

Appendix C: DoD Installations with a Known or Suspected Release of PFOS/PFOA

DoD Component	Installation Name	State/Territory	Investigation Costs[1] (thousands of dollars)	Cleanup Costs[2] (thousands of dollars)	Total Cost through Dec 31, 2016 (thousands of dollars)
Army - Active	Aberdeen Proving Ground	Maryland	$130.2	$0.0	$130.2
Army - Active	Army Aviation Support Facility 1 Ronkonkoma New York	New York	$0.0	$0.0	$0.0
Army - Active	Army Aviation Support Facility 2 Rochester New York	New York	$0.0	$0.0	$0.0
Army - Active	Army Aviation Support Facility 3 New York	New York	$0.0	$0.0	$0.0
Army - Active	Army Aviation Support Facility 3333 Skyway Dr Montana	Montana	$0.0	$0.0	$0.0
Army - Active	Army Aviation Support Facility Greenville	South Carolina	$0.0	$0.0	$0.0
Army - Active	Army National Guard Armory	Montana	$0.0	$0.0	$0.0
Army - Active	Army National Guard Facility Casper, Wyoming	Wyoming	$0.0	$0.0	$0.0
Army - Active	Austin Bergstrom Hangar	Texas	$0.0	$0.0	$0.0
Army - Active	Aviation Support Facility Johnstown	Pennsylvania	$0.0	$0.0	$0.0
Army - Active	Aviation Support Facility New Century	Kansas	$0.0	$0.0	$0.0
Army - Active	Bangor Armed Forces Reserve Center	Maine	$0.0	$0.0	$0.0
Army - Active	Brunswick Armed Forces Reserve Center	Maine	$0.0	$0.0	$0.0
Army - Active	Camp Minden Training Site former Louisiana Army Ammunition Plant	Louisiana	$0.0	$0.0	$0.0
Army - Active	Camp Navajo	Arizona	$0.0	$0.0	$0.0
Army - Active	Camp Pendleton State Military Reservation	Virginia	$0.0	$0.0	$0.0
Army - Active	Camp Roberts Building 7020 (Former Fire Training Area, CPRO-39)	California	$0.0	$0.0	$0.0
Army - BRAC	Devens[3]	Massachusetts	$126.8	$0.0	$126.8
Army - Active	Ethan Allen Firing Range	Vermont	$0.0	$0.0	$0.0
Army - Active	Former Crash Fire Station, Building 241	New Hampshire	$0.0	$0.0	$0.0
Army - Active	Fort Bragg	North Carolina	$0.0	$0.0	$0.0
Army - Active	Fort Campbell	Kentucky	$0.0	$0.0	$0.0
Army - Active	Fort Carson	Colorado	$23.5	$0.0	$23.5
Army - Active	Fort Drum	New York	$623.0	$0.0	$623.0
Army - Active and BRAC	Fort Greely	Alaska	$0.0	$0.0	$0.0
Army - Active	Fort Hunter Liggett	California	$0.0	$0.0	$0.0
Army - Active	Fort Irwin	California	$0.0	$0.0	$0.0
Army - Active	Fort Jackson	South Carolina	$0.0	$0.0	$0.0
Army - Active	Fort Knox	Kentucky	$0.0	$0.0	$0.0
Army - Active	Fort Leavenworth	Kansas	$0.0	$0.0	$0.0
Army - Active	Fort Lee	Virginia	$5.0	$0.0	$5.0
Army - Active	Fort McCoy	Wisconsin	$12.0	$0.0	$12.0
Army - BRAC	Fort Meade BRAC	Maryland	$9.5	$0.0	$9.5
Army - BRAC	Fort Ord	California	$73.5	$0.0	$73.5

Appendix C: DoD Installations with a Known or Suspected Release of PFOS/PFOA

DoD Component	Installation Name	State/Territory	Investigation Costs[1] (thousands of dollars)	Cleanup Costs[2] (thousands of dollars)	Total Cost through Dec 31, 2016 (thousands of dollars)
Army - BRAC	Fort Pickett	Virginia	$0.0	$0.0	$0.0
Army - Active	Fort Rucker	Alabama	$0.0	$0.0	$0.0
Army - Active	Fort Sill	Oklahoma	$0.0	$0.0	$0.0
Army - Active	Fort Stewart, Georgia	Georgia	$0.0	$0.0	$0.0
Army - Active	Fort Wainwright	Alaska	$0.0	$0.0	$0.0
Army - Active	Garrison Bldg 15 Guernsey, Wyoming	Wyoming	$0.0	$0.0	$0.0
Army - Active	Grand Prairie Hangar	Texas	$0.0	$0.0	$0.0
Army - Active	Hunter Army Airfield	Georgia	$0.0	$0.0	$0.0
Army - Active	Jackson Airport Armory	Mississippi	$0.0	$0.0	$0.0
Army - Active	Joint Base Berry Field	Tennessee	$0.0	$0.0	$0.0
Army - Active	Joint Base Lewis-McChord	Washington	$20.0	$0.0	$20.0
Army - Active	Letterkenny Army Depot	Pennsylvania	$234.6	$0.0	$234.6
Army - Active	Los Alamitos Joint Forces Training Base	California	$0.0	$0.0	$0.0
Army - Active	Martindale Hangar	Texas	$0.0	$0.0	$0.0
Army - Active	McEntire Air National Guard Station/Army Aviation Support Facility	South Carolina	$0.0	$0.0	$0.0
Army - Active	Muscatatuck Urban Training Complex Butlerville, Indiana	Indiana	$0.0	$0.0	$0.0
Army - Active	National Guard Tempe Readiness Center Arizona	Arizona	$0.0	$0.0	$0.0
Army - Active	North Penn U.S. Army Reserve Center	Pennsylvania	$12.9	$0.0	$12.9
Army - Active	Range 36 Air-to-Ground, Indiana	Indiana	$0.0	$0.0	$0.0
Army - Active	Sacramento Army Aviation Support Facility	California	$0.0	$0.0	$0.0
Army - BRAC	Seneca Army Ammunition Plant[3]	New York	$238.0	$0.0	$238.0
Army - Active	Shelbyville Army Aviation Support Facility	Indiana	$0.0	$0.0	$0.0
Army - Active	Silver Bell Army Heliport Arizona	Arizona	$0.0	$0.0	$0.0
Army - Active	Smyrna Volunteer Training Site	Tennessee	$0.0	$0.0	$0.0
Army - Active	State Military Reservation	New York	$0.0	$0.0	$0.0
Army - BRAC	Sudbury[3]	Massachusetts	$64.1	$0.0	$64.1
Army - BRAC	Umatilla Chemical Depot/Well #4/Sample # 16-6746-AZW6A	Oregon	$0.0	$0.0	$0.0
Army - Active	USAG Kwajalein Atoll	Marshall Islands	$0.0	$0.0	$0.0
Army - Active	Yakima Training Center	Washington	$0.0	$0.0	$0.0
Army - Active	Yuma Proving Ground/Kofa Firing Range	Arizona	$0.0	$0.0	$0.0
		Army Subtotals:	**$1,573.1**	**$0.0**	**$1,573.1**

Appendix C: DoD Installations with a Known or Suspected Release of PFOS/PFOA

DoD Component	Installation Name	State/Territory	Investigation Costs[1] (thousands of dollars)	Cleanup Costs[2] (thousands of dollars)	Total Cost through Dec 31, 2016 (thousands of dollars)
Navy - BRAC	Adak Alaska Naval Air Facility	Alaska	$0.0	$0.0	$0.0
Navy - BRAC	Agana	Guam	$58.0	$0.0	$58.0
Navy - BRAC	Alameda	California	$120.0	$0.0	$120.0
Navy - Active	Amchitka Alaska	Alaska	$0.0	$0.0	$0.0
Navy - Active	Anacostia Naval Station	District of Columbia	$0.0	$0.0	$0.0
Navy - BRAC	Annapolis	Maryland	$351.0	$0.0	$351.0
Navy - Active	Bainbridge Maryland Naval Training Center	Maryland	$0.0	$0.0	$0.0
Navy - Active and BRAC	Barbers Point Naval Air Station	Hawaii	$0.0	$0.0	$0.0
Navy - Active	Barking Sands Hawaii F Pacific Missile Range Facility	Hawaii	$0.0	$0.0	$0.0
Navy - Active	Barrow	Alaska	$151.0	$0.0	$151.0
Navy - Active	Bedford Massachusetts Naval Weapons Industrial Reserve Plant	Massachusetts	$0.0	$0.0	$0.0
Navy - Active	Bethpage New York Naval Weapons Industrial Reserve Plant	New York	$0.0	$0.0	$0.0
Navy - Active	Bloomfield Connecticut Naval Weapons Industrial Reserve Plant	Connecticut	$0.0	$0.0	$0.0
Navy - Active	Bristol Tennessee Naval Weapons Industrial Reserve Plant	Tennessee	$0.0	$0.0	$0.0
Navy - BRAC	Brunswick	Maine	$973.0	$0.0	$973.0
Navy - Active	Calverton	New York	$374.0	$0.0	$374.0
Navy - BRAC	Cecil Field Naval Air Station	Florida	$0.0	$0.0	$0.0
Navy - BRAC	Charleston Naval Shipyard	South Carolina	$0.0	$0.0	$0.0
Navy - BRAC	Charleston Naval Station	South Carolina	$0.0	$0.0	$0.0
Navy - BRAC	Chase Field Naval Air Station	Texas	$0.0	$0.0	$0.0
Navy - Active	Chesapeake Beach	Maryland	$151.0	$0.0	$151.0
Navy - Active	Chesapeake Virginia St. Julian's Creek	Virginia	$0.0	$0.0	$0.0
Navy - Active	China Lake	California	$75.0	$0.0	$75.0
Navy - BRAC	Concord Naval Weapons Station	California	$0.0	$0.0	$0.0
Navy - Active	Corpus Christi Texas Naval Air Station	Texas	$0.0	$0.0	$0.0
Navy - Active	Crane	Indiana	$3.0	$0.0	$3.0
Navy - Active	Craney Island Virginia Navy Fuel Depot/Naval Supply Center	Virginia	$0.0	$0.0	$0.0
Navy - BRAC	Crows Naval Auxiliary Landing Field	California	$0.0	$0.0	$0.0
Navy - Active	Cutler	Maine	$14.3	$0.0	$14.3
Navy - Active	Dahlgren Virginia Naval Surface Warfare Center	Virginia	$0.0	$0.0	$0.0
Navy - BRAC	Dallas	Texas	$41.0	$0.0	$41.0
Navy - Active	Dallas Texas Naval Weapons Industrial Reserve Plant	Texas	$0.0	$0.0	$0.0
Navy - Active	Dam Neck Virginia	Virginia	$0.0	$0.0	$0.0

Appendix C: DoD Installations with a Known or Suspected Release of PFOS/PFOA

DoD Component	Installation Name	State/Territory	Investigation Costs[1] (thousands of dollars)	Cleanup Costs[2] (thousands of dollars)	Total Cost through Dec 31, 2016 (thousands of dollars)
Navy - BRAC	Davisville	Rhode Island	$21.0	$0.0	$21.0
Navy - BRAC	Driver Navy Radio Transmitter Facility	Virginia	$0.0	$0.0	$0.0
Navy - Active	Earle	New Jersey	$786.0	$59.0	$845.0
Navy - Active	El Centro California Naval Air Facility	California	$0.0	$0.0	$0.0
Navy - Active	Fallon	Nevada	$211.8	$0.0	$211.8
Navy - Active	Fleet and Industrial Supply Center Jacksonville	Florida	$0.0	$0.0	$0.0
Navy - Active	Fort Worth Texas Naval Air Station Joint Reserve Base	Texas	$0.0	$0.0	$0.0
Navy - BRAC	Glenview Naval Air Station	Illinois	$0.0	$0.0	$0.0
Navy - Active	Great Lakes	Illinois	$5.0	$0.0	$5.0
Navy - Active	Gulfport	Mississippi	$150.7	$0.0	$150.7
Navy - BRAC	Hunters Point Annex	California	$0.0	$0.0	$0.0
Navy - Active	Imperial Beach California	California	$0.0	$0.0	$0.0
Navy - Active	Indian Head Maryland Naval Surface Warfare Center	Maryland	$0.0	$0.0	$0.0
Navy - Active	Jacksonville	Florida	$25.0	$0.0	$25.0
Navy - Active	Joint Base Pearl Harbor-Hickam	Hawaii	$0.0	$0.0	$0.0
Navy - Active	Key West Florida Naval Air Station	Florida	$0.0	$0.0	$0.0
Navy - Active	Keyport Washington Naval Undersea Warfare Center	Washington	$0.0	$0.0	$0.0
Navy - Active	Kings Bay	Georgia	$3.0	$0.0	$3.0
Navy - Active	Kingsville Texas Naval Air Station	Texas	$0.0	$0.0	$0.0
Navy - Active	Lemoore California Naval Air Station	California	$0.0	$0.0	$0.0
Navy - Active	Little Creek Virginia Naval Amphibious Base	Virginia	$0.0	$0.0	$0.0
Navy - BRAC	Long Beach Naval Shipyard	California	$0.0	$0.0	$0.0
Navy - BRAC	Long Beach Naval Station	California	$0.0	$0.0	$0.0
Navy - BRAC	Louisville Crane Division Naval Ordnance Station/Naval Surface Warfare Center	Kentucky	$0.0	$0.0	$0.0
Navy - BRAC	Mare Island Naval Shipyard	California	$0.0	$0.0	$0.0
Navy - Active	Mayport	Florida	$12.0	$0.0	$12.0
Navy - Active	McClennan Texas Naval Industrial Reserve Ordnance Plant	Texas	$0.0	$0.0	$0.0
Navy - Active	Meridian	Mississippi	$925.0	$0.0	$925.0
Navy - BRAC	Midway Island Naval Air Facility	Midway Islands	$0.0	$0.0	$0.0
Navy - Active and BRAC	Millington	Tennessee	$15.0	$0.0	$15.0
Navy - Active	Minneapolis Minnesota Naval Industrial Reserve Ordnance Plant	Minnesota	$0.0	$0.0	$0.0
Navy - Active	Naval Air Station Whidbey Island	Washington	$1,284.0	$90.0	$1,374.0
Navy - Active	Naval Auxiliary Landing Field Fentress (Oceana)	Virginia	$2,706.0	$96.5	$2,802.5

Appendix C: DoD Installations with a Known or Suspected Release of PFOS/PFOA

DoD Component	Installation Name	State/Territory	Investigation Costs[1] (thousands of dollars)	Cleanup Costs[2] (thousands of dollars)	Total Cost through Dec 31, 2016 (thousands of dollars)
Navy - Active	Naval Base Coronado	California	$0.0	$0.0	$0.0
Navy - Active	Naval Base San Diego	California	$0.0	$0.0	$0.0
Navy - Active	Naval Command Telecommunications Station Stockton	California	$0.0	$0.0	$0.0
Navy - Active	Naval District Command	District of Columbia	$15.0	$0.0	$15.0
Navy - Active	Naval Support Activity Andersen Guam	Guam	$0.0	$0.0	$0.0
Navy - Active	Naval Surface Warfare Center Carderock	Maryland	$0.0	$0.0	$0.0
Navy - Active	Naval Surface Warfare Center Division Panama City	Florida	$0.0	$0.0	$0.0
Navy - Active	Navy Munitions Command East Asia Division Pearl Harbor	Hawaii	$0.0	$0.0	$0.0
Navy - Active	Navy Munitions Command Yorktown	Virginia	$0.0	$0.0	$0.0
Navy - Active	New London	Connecticut	$20.0	$0.0	$20.0
Navy - Active	New Orleans Louisiana Naval Air Station Joint Reserve Base	Louisiana	$0.0	$0.0	$0.0
Navy - Active	Newport	Rhode Island	$228.4	$0.0	$228.4
Navy - Active	Norfolk Virginia Naval Base	Virginia	$0.0	$0.0	$0.0
Navy - BRAC	Orlando Naval Training Center	Florida	$0.0	$0.0	$0.0
Navy - Active	Patuxent River	Maryland	$234.0	$0.0	$234.0
Navy - Active	Pearl Harbor - Fleet and Industrial Supply Center	Hawaii	$456.5	$0.0	$456.5
Navy - Active	Pearl Harbor - Naval Facilities Engineering Command	Hawaii	$181.0	$0.0	$181.0
Navy - Active	Pearl Harbor Hawaii Naval Shipyard	Hawaii	$0.0	$0.0	$0.0
Navy - Active	Pensacola	Florida	$439.0	$0.0	$439.0
Navy - BRAC	Philadelphia Naval Station	Pennsylvania	$0.0	$0.0	$0.0
Navy - Active	Port Hueneme	California	$9.0	$0.0	$9.0
Navy - Active	Portsmouth Naval Shipyard	Maine	$0.0	$0.0	$0.0
Navy - Active	Portsmouth Virginia Norfolk Naval Shipyard	Virginia	$0.0	$0.0	$0.0
Navy - Active	Pt Mugu	California	$353.2	$0.0	$353.2
Navy - BRAC	Puerto Rico Naval Activity	Puerto Rico	$0.0	$0.0	$0.0
Navy - Active	Puget Sound Fleet and Industrial Supply Center Manchester	Washington	$0.0	$0.0	$0.0
Navy - BRAC	Puget Sound Naval Station Sand Point	Washington	$0.0	$0.0	$0.0
Navy - Active	Puget Sound Washington Naval Shipyard	Washington	$0.0	$0.0	$0.0
Navy - Active	Rocket Center West Virginia Allegheny Ballistics Laboratory	West Virginia	$0.0	$0.0	$0.0
Navy - Active	San Diego California Auxiliary Landing Field	California	$0.0	$0.0	$0.0
Navy - Active	San Diego California Fleet Anti-Submarine Warfare Training Center Pacific	California	$0.0	$0.0	$0.0
Navy - Active	San Diego California NISE-WEST	California	$0.0	$0.0	$0.0
Navy - Active	San Nicolas Island California Outlying Landing Field	California	$0.0	$0.0	$0.0
Navy - Active	Saufley Field	Florida	$3.0	$0.0	$3.0

Appendix C: DoD Installations with a Known or Suspected Release of PFOS/PFOA

DoD Component	Installation Name	State/Territory	Investigation Costs[1] (thousands of dollars)	Cleanup Costs[2] (thousands of dollars)	Total Cost through Dec 31, 2016 (thousands of dollars)
Navy - Active	Seal Beach California Naval Weapons Station	California	$0.0	$0.0	$0.0
Navy - Active	Solomons Maryland Naval Recreation Center	Maryland	$0.0	$0.0	$0.0
Navy - BRAC	South Weymouth	Massachusetts	$1,000.0	$0.0	$1,000.0
Navy - Active	Space and Naval Warfare Systems Center Pacific San Diego	California	$0.0	$0.0	$0.0
Navy - BRAC	Treasure Island	California	$6.0	$0.0	$6.0
Navy - BRAC	Trenton	New Jersey	$338.0	$0.0	$338.0
Navy - Active	Walter Reed National Military Medical Center	Maryland	$0.0	$0.0	$0.0
Navy - BRAC	Warminster	Pennsylvania	$3,218.0	$12,966.0	$16,184.0
Navy - Active	Washington DC Naval Research Laboratory	District of Columbia	$0.0	$0.0	$0.0
Navy - Active	Washington DC Naval Security Station	District of Columbia	$0.0	$0.0	$0.0
Navy - BRAC	White Oak - Naval Surface Warfare Center Dahlgren Division Detachment (Silver Spring)	Maryland	$0.0	$0.0	$0.0
Navy - Active	Whiting Field	Florida	$111.0	$0.0	$111.0
Navy - BRAC	Willow Grove	Pennsylvania	$4,065.0	$10,862.0	$14,927.0
Navy - BRAC	New Potential Area of Concern Preliminary Assessments[4]	Various	$115.0	$0.0	$115.0
		Navy Subtotals:	**$19,247.9**	**$24,073.5**	**$43,321.4**
USMC - Active[5]	Barstow	California	$504.0	$0.0	$504.0
USMC - Active[5]	Beaufort South Carolina Marine Corps Air Station	South Carolina	$0.0	$0.0	$0.0
USMC - Active[5]	Camp Lejeune	North Carolina	$225.0	$0.0	$225.0
USMC - Active[5]	Camp Pendleton California Marine Corps Base	California	$0.0	$0.0	$0.0
USMC - Active[5]	Cherry Point	North Carolina	$20.5	$0.0	$20.5
USMC - BRAC[5]	El Toro Marine Corps Air Station	California	$0.0	$0.0	$0.0
USMC - Active[5]	Kaneohe Bay Hawaii Marine Corps Base	Hawaii	$0.0	$0.0	$0.0
USMC - Active[5]	Miramar California Marine Corps Air Station	California	$0.0	$0.0	$0.0
USMC - Active[5]	Parris Island South Carolina Marine Corps Recruit Depot	South Carolina	$0.0	$0.0	$0.0
USMC - Active[5]	Quantico	Virginia	$44.5	$0.0	$44.5
USMC - Active[5]	San Juan Puerto Rico Marine Corps Recruiting Command	Puerto Rico	$0.0	$0.0	$0.0
USMC - BRAC[5]	Tustin	California	$143.0	$0.0	$143.0
USMC - Active[5]	Twentynine Palms	California	$10.0	$0.0	$10.0
USMC - Active[5]	Yuma	Arizona	$318.0	$0.0	$318.0
		USMC Subtotals:	**$1,265.0**	**$0.0**	**$1,265.0**

Appendix C: DoD Installations with a Known or Suspected Release of PFOS/PFOA

DoD Component	Installation Name	State/Territory	Investigation Costs[1] (thousands of dollars)	Cleanup Costs[2] (thousands of dollars)	Total Cost through Dec 31, 2016 (thousands of dollars)
Air Force-Active	Air Force Plant 3	Oklahoma	$790.7	$0.0	$790.7
Air Force-Active	Air Force Plant 36	Ohio	$81.4	$0.0	$81.4
Air Force-Active	Air Force Plant 4	Texas	$790.7	$0.0	$790.7
Air Force-Active	Air Force Plant 42	California	$790.7	$0.0	$790.7
Air Force-Active	Air Force Plant 44	Arizona	$81.4	$0.0	$81.4
Air Force-Active	Air Force Plant 6	Georgia	$399.8	$0.0	$399.8
Air Force-Active	Air Force Plant 85	Ohio	$439.3	$0.0	$439.3
Air Force-Active	Air Force Plant PJKS	Colorado	$439.3	$0.0	$439.3
Air Force-BRAC	Air Force Research Laboratory Mesa	Arizona	$74.0	$0.0	$74.0
Air Force-Active	Air Force Research Laboratory Rome	New York	$392.9	$0.0	$392.9
Air Force-ANG	Alpena	Michigan	$131.9	$0.0	$131.9
Air Force-Active	Altus AFB	Oklahoma	$816.1	$0.0	$816.1
Air Force-Active	Arnold AFB	Tennessee	$790.7	$0.0	$790.7
Air Force-ANG	Atlantic City	New Jersey	$115.7	$0.0	$115.7
Air Force-Active	Avon Park Air Force Reserve	Florida	$392.9	$0.0	$392.9
Air Force-ANG	Bangor International Airport	Maine	$115.7	$0.0	$115.7
Air Force-Active	Barksdale AFB	Louisiana	$790.7	$0.0	$790.7
Air Force-ANG	Barnes Municipal	Massachusetts	$91.7	$0.0	$91.7
Air Force-Active	Beale AFB	California	$814.4	$0.0	$814.4
Air Force-Active	Bellows Air Force Station	Hawaii	$81.4	$0.0	$81.4
Air Force-BRAC	Bergstrom AFB	Texas	$1,255.0	$0.0	$1,255.0
Air Force-ANG	Birmingham International Airport	Alabama	$67.7	$0.0	$67.7
Air Force-ANG	Boise	Idaho	$155.9	$0.0	$155.9
Air Force-ANG	Bradley International Airport	Connecticut	$67.7	$0.0	$67.7
Air Force-BRAC	Brooks-City Base	Texas	$73.0	$0.0	$73.0
Air Force-Active	Buckley AFB	Colorado	$439.3	$0.0	$439.3
Air Force-BRAC	Buckley Annex	Colorado	$60.0	$0.0	$60.0
Air Force-ANG	Burlington	Vermont	$107.9	$0.0	$107.9
Air Force-Active	Calumet Air Force Station	Michigan	$58.2	$0.0	$58.2
Air Force-Active	Cannon AFB	New Mexico	$790.7	$0.0	$790.7
Air Force-Active	Cape Canaveral Air Force Station	Florida	$1,743.8	$0.0	$1,743.8
Air Force-BRAC	Carswell AFB	Texas	$73.0	$0.0	$73.0
Air Force-BRAC	Castle AFB	California	$2,260.0	$0.0	$2,260.0
Air Force-Active	Cavalier Air Force Station	North Dakota	$8.9	$0.0	$8.9
Air Force-ANG	Channel Islands	California	$67.7	$0.0	$67.7

Appendix C: DoD Installations with a Known or Suspected Release of PFOS/PFOA

DoD Component	Installation Name	State/Territory	Investigation Costs[1] (thousands of dollars)	Cleanup Costs[2] (thousands of dollars)	Total Cost through Dec 31, 2016 (thousands of dollars)
Air Force-BRAC	Chanute AFB	Illinois	$2,805.0	$360.0	$3,165.0
Air Force-ANG	Charlotte Douglas	North Carolina	$139.7	$0.0	$139.7
Air Force-Active	Cheyenne Mountain Air Force Station	Colorado	$72.5	$0.0	$72.5
Air Force-ANG	Cheyenne Municipal	Wyoming	$127.7	$0.0	$127.7
Air Force-Active	Clear Air Force Station	Alaska	$772.5	$0.0	$772.5
Air Force-Active	Columbus AFB	Mississippi	$790.7	$0.0	$790.7
Air Force-Active	Creech AFB	Nevada	$674.7	$0.0	$674.7
Air Force-Active	Davis-Monthan AFB	Arizona	$790.7	$0.0	$790.7
Air Force-ANG	Des Moines	Iowa	$175.7	$0.0	$175.7
Air Force-Active	Dobbins Air Reserve Base	Georgia	$392.9	$0.0	$392.9
Air Force-Active	Dover AFB	Delaware	$541.2	$27.5	$568.7
Air Force-ANG	Duluth International Airport	Minnesota	$131.9	$0.0	$131.9
Air Force-Active	Dyess AFB	Texas	$790.7	$0.0	$790.7
Air Force-BRAC	Eaker AFB	Arkansas	$1,073.0	$0.0	$1,073.0
Air Force-Active	Eareckson AFB	Alaska	$8.9	$0.0	$8.9
Air Force-Active	Edwards AFB	California	$667.7	$0.0	$667.7
Air Force-Active	Eglin AFB	Florida	$937.4	$0.0	$937.4
Air Force-Active	Eielson AFB	Alaska	$920.8	$8,734.0	$9,654.8
Air Force-ANG	Ellington Field	Texas	$115.7	$0.0	$115.7
Air Force-Active	Ellsworth AFB	South Dakota	$587.6	$1,706.9	$2,294.5
Air Force-BRAC	England AFB	Louisiana	$1,435.0	$0.0	$1,435.0
Air Force-ANG	EWVRA Shepherd Field (Martinsburg)	West Virginia	$127.7	$0.0	$127.7
Air Force-Active	Fairchild AFB	Washington	$790.7	$0.0	$790.7
Air Force-Active	FE Warren AFB	Wyoming	$586.0	$0.0	$586.0
Air Force-ANG	Forbes Field	Kansas	$115.7	$0.0	$115.7
Air Force-ANG	Fort Wayne Municipal	Indiana	$115.7	$0.0	$115.7
Air Force-BRAC	Four Lakes Air National Guard Station	Washington	$60.0	$0.0	$60.0
Air Force-ANG	Francis S. Gabreski	New York	$199.7	$0.0	$199.7
Air Force-ANG	Fresno Air Guard	California	$115.7	$0.0	$115.7
Air Force-ANG	Ft. Smith	Arkansas	$139.7	$0.0	$139.7
Air Force-BRAC	Galena Forward Operating Location	Alaska	$1,075.0	$0.0	$1,075.0
Air Force-ANG	General Mitchell	Wisconsin	$175.7	$0.0	$175.7
Air Force-BRAC	General Mitchell Air Reserve Station	Wisconsin	$1,762.0	$0.0	$1,762.0
Air Force-BRAC	Gentile Air Force Station	Ohio	$1,060.0	$0.0	$1,060.0
Air Force-BRAC	George AFB	California	$1,795.0	$0.0	$1,795.0

Appendix C: DoD Installations with a Known or Suspected Release of PFOS/PFOA

DoD Component	Installation Name	State/Territory	Investigation Costs[1] (thousands of dollars)	Cleanup Costs[2] (thousands of dollars)	Total Cost through Dec 31, 2016 (thousands of dollars)
Air Force-Active	Goodfellow AFB	Texas	$790.7	$0.0	$790.7
Air Force-Active	Grand Forks AFB	North Dakota	$439.3	$0.0	$439.3
Air Force-ANG	Great Falls International Airport	Montana	$103.7	$0.0	$103.7
Air Force-ANG	Greater Peoria	Illinois	$127.7	$0.0	$127.7
Air Force-BRAC	Griffiss AFB	New York	$2,000.0	$0.0	$2,000.0
Air Force-BRAC	Grissom AFB	Indiana	$1,423.0	$0.0	$1,423.0
Air Force-Active	Grissom Air Reserve Base	Indiana	$439.3	$0.0	$439.3
Air Force-ANG	Gulfport Biloxi	Mississippi	$163.7	$0.0	$163.7
Air Force-ANG	Hancock Field	New York	$151.7	$0.0	$151.7
Air Force-Active	Hanscom AFB	Massachusetts	$468.0	$0.0	$468.0
Air Force-ANG	Harrisburg International Airport	Pennsylvania	$43.7	$0.0	$43.7
Air Force-ANG	Hector Field	North Dakota	$127.7	$0.0	$127.7
Air Force-Active	Hill AFB	Utah	$587.6	$0.0	$587.6
Air Force-Active	Holloman AFB	New Mexico	$790.7	$0.0	$790.7
Air Force-BRAC	Homestead AFB	Florida	$1,073.0	$0.0	$1,073.0
Air Force-Active	Homestead Air Reserve Base	Florida	$392.9	$0.0	$392.9
Air Force-ANG	Horsham	Pennsylvania	$127.7	$6,300.0	$6,427.7
Air Force-ANG	Hulman	Indiana	$115.7	$0.0	$115.7
Air Force-Active	Hurlburt Field	Florida	$790.7	$0.0	$790.7
Air Force-ANG	Jackson	Mississippi	$119.9	$0.0	$119.9
Air Force-ANG	Jacksonville	Florida	$203.9	$0.0	$203.9
Air Force-ANG	Joe Foss Field (Sioux Falls)	South Dakota	$151.7	$0.0	$151.7
Air Force-Active	Joint Base Andrews	Maryland	$392.9	$0.0	$392.9
Air Force-Active	Joint Base Cape Cod (Massachusetts Military Reservation)	Massachusetts	$1,317.6	$305.5	$1,623.1
Air Force-Active	Joint Base Charleston	South Carolina	$392.9	$0.0	$392.9
Air Force-Active	Joint Base Elmendorf-Richardson	Alaska	$1,542.8	$0.0	$1,542.8
Air Force-Active	Joint Base Langley-Eustis	Virginia	$785.8	$0.0	$785.8
Air Force-Active	Joint Base McGuire-Dix-Lakehurst	New Jersey	$617.3	$1,187.8	$1,805.1
Air Force-Active	Joint Base San Antonio - Lackland, Randolph, Ft Sam Houston, Camp Bullis	Texas	$2,272.1	$0.0	$2,272.1
Air Force-Active	Keesler AFB	Mississippi	$790.7	$0.0	$790.7
Air Force-BRAC	Kelly AFB	Texas	$1,946.0	$0.0	$1,946.0
Air Force-ANG	Key Field	Mississippi	$143.9	$0.0	$143.9
Air Force-BRAC	KI Sawyer AFB	Michigan	$2,395.0	$0.0	$2,395.0
Air Force-Active	King Salmon	Alaska	$51.8	$0.0	$51.8

Appendix C: DoD Installations with a Known or Suspected Release of PFOS/PFOA

DoD Component	Installation Name	State/Territory	Investigation Costs[1] (thousands of dollars)	Cleanup Costs[2] (thousands of dollars)	Total Cost through Dec 31, 2016 (thousands of dollars)
Air Force-Active	Kirtland AFB	New Mexico	$667.7	$0.0	$667.7
Air Force-ANG	Klamath Falls	Oregon	$103.7	$0.0	$103.7
Air Force-BRAC	Kulis Air National Guard Base	Alaska	$1,060.0	$0.0	$1,060.0
Air Force-ANG	Lambert St. Louis	Missouri	$55.7	$0.0	$55.7
Air Force-Active	Laughlin AFB	Texas	$790.7	$0.0	$790.7
Air Force-ANG	Lincoln Municipal	Nebraska	$163.7	$0.0	$163.7
Air Force-Active	Little Rock AFB	Arkansas	$790.7	$0.0	$790.7
Air Force-BRAC	Loring AFB	Maine	$2,441.0	$0.0	$2,441.0
Air Force-Active	Los Angeles AFB	California	$72.5	$0.0	$72.5
Air Force-BRAC	Lowry AFB	Colorado	$240.0	$0.0	$240.0
Air Force-Active	Luke AFB	Arizona	$790.7	$0.0	$790.7
Air Force-Active	MacDill AFB	Florida	$790.7	$0.0	$790.7
Air Force-Active	Malmstrom AFB	Montana	$439.3	$0.0	$439.3
Air Force-ANG	Mansfield	Ohio	$127.7	$0.0	$127.7
Air Force-BRAC	March AFB	California	$1,364.0	$1.0	$1,365.0
Air Force-Active	March Air Reserve Base	California	$790.7	$0.0	$790.7
Air Force-ANG	Martin State	Maryland	$139.7	$0.0	$139.7
Air Force-BRAC	Mather AFB	California	$1,571.0	$197.0	$1,768.0
Air Force-Active	Maxwell Gunter AFB	Alabama	$790.7	$0.0	$790.7
Air Force-BRAC	McClellan AFB	California	$1,144.0	$0.0	$1,144.0
Air Force-Active	McConnell AFB	Kansas	$439.3	$0.0	$439.3
Air Force-ANG	McEntire Air Guard	South Carolina	$223.7	$0.0	$223.7
Air Force-ANG	McGhee-Tyson	Tennessee	$127.7	$0.0	$127.7
Air Force-ANG	Memphis International Airport	Tennessee	$55.7	$0.0	$55.7
Air Force-Active	Minneapolis-St Paul Air Reserve Station	Minnesota	$69.9	$0.0	$69.9
Air Force-ANG	Minneapolis-St Paul International Airport	Minnesota	$69.8	$0.0	$69.8
Air Force-Active	Minot AFB	New Dakota	$439.3	$0.0	$439.3
Air Force-ANG	Moffett Field	California	$31.7	$0.0	$31.7
Air Force-ANG	Montgomery Regional (Dannelly Field)	Alabama	$79.7	$0.0	$79.7
Air Force-Active	Moody AFB	Georgia	$392.9	$0.0	$392.9
Air Force-Active	Mountain Home AFB	Idaho	$790.7	$0.0	$790.7
Air Force-BRAC	Myrtle Beach AFB	South Carolina	$1,246.0	$0.0	$1,246.0
Air Force-ANG	Nashville Metro	Tennessee	$55.7	$0.0	$55.7
Air Force-Active	Nellis AFB	Nevada	$667.7	$0.0	$667.7
Air Force-Active	New Boston Air Force Station	New Hampshire	$8.9	$0.0	$8.9

Appendix C: DoD Installations with a Known or Suspected Release of PFOS/PFOA

DoD Component	Installation Name	State/Territory	Investigation Costs[1] (thousands of dollars)	Cleanup Costs[2] (thousands of dollars)	Total Cost through Dec 31, 2016 (thousands of dollars)
Air Force-ANG	New Castle	Delaware	$103.7	$0.0	$103.7
Air Force-BRAC	Newark AFB	Ohio	$1,060.0	$0.0	$1,060.0
Air Force-Active	Niagara Falls Air Reserve Station	New York	$399.8	$0.0	$399.8
Air Force-BRAC	Norton AFB	California	$1,467.0	$0.0	$1,467.0
Air Force-Active	Offutt AFB	Nebraska	$439.3	$0.0	$439.3
Air Force-BRAC	O'Hare Air Reserve Station	Illinois	$76.0	$0.0	$76.0
Air Force-BRAC	Onizuka Air Force Station	California	$60.0	$0.0	$60.0
Air Force-BRAC	Ontario Air Force Station	California	$74.0	$0.0	$74.0
Air Force-Active	Patrick AFB	Florida	$939.0	$0.0	$939.0
Air Force-ANG	Pease	New Hampshire	$67.7	$0.0	$67.7
Air Force-BRAC	Pease AFB	New Hampshire	$12,500.0	$4,000.0	$16,500.0
Air Force-Active	Peterson AFB	Colorado	$1,303.7	$4,127.7	$5,431.4
Air Force-Active	Pittsburgh Air Force	Pennsylvania	$171.8	$0.0	$171.8
Air Force-ANG	Pittsburgh Air Force Reserve Command	Pennsylvania	$171.8	$0.0	$171.8
Air Force-BRAC	Plattsburgh International Airport	New York	$2,042.0	$30.0	$2,072.0
Air Force-ANG	Portland International Airport	Oregon	$115.7	$0.0	$115.7
Air Force-ANG	Puerto Rico Munoz International Airport	Puerto Rico	$127.7	$0.0	$127.7
Air Force-ANG	Quonset Point State Airport	Rhode Island	$55.7	$0.0	$55.7
Air Force-BRAC	Reese AFB	Texas	$1,554.0	$0.0	$1,554.0
Air Force-ANG	Reno Tahoe	Nevada	$139.7	$0.0	$139.7
Air Force-BRAC	Richards-Gebaur AFB	Missouri	$1,307.0	$0.0	$1,307.0
Air Force-ANG	Richmond International Airport Byrd Field	Virginia	$67.7	$0.0	$67.7
Air Force-ANG	Rickenbacker	Ohio	$79.7	$0.0	$79.7
Air Force-BRAC	Rickenbacker Air National Guard Base	Ohio	$1,074.0	$0.0	$1,074.0
Air Force-Active	Robins AFB	Georgia	$1,206.5	$0.0	$1,206.5
Air Force-ANG	Rosecrans Memorial	Missouri	$103.7	$0.0	$103.7
Air Force-BRAC	Roslyn Air National Guard Station	New York	$60.0	$0.0	$60.0
Air Force-ANG	Salt Lake City	Utah	$71.9	$0.0	$71.9
Air Force-ANG	Savannah International Airport	Georgia	$163.7	$0.0	$163.7
Air Force-ANG	Schenectady Airport	New York	$223.7	$0.0	$223.7
Air Force-Active	Schriever AFB	Colorado	$81.4	$0.0	$81.4
Air Force-Active	Scott AFB	Illinois	$439.3	$0.0	$439.3
Air Force-ANG	Selfridge	Michigan	$307.7	$0.0	$307.7
Air Force-Active	Seymour Johnson AFB	North Carolina	$392.9	$0.0	$392.9
Air Force-Active	Shaw AFB	South Carolina	$392.9	$0.0	$392.9

Appendix C: DoD Installations with a Known or Suspected Release of PFOS/PFOA

DoD Component	Installation Name	State/Territory	Investigation Costs[1] (thousands of dollars)	Cleanup Costs[2] (thousands of dollars)	Total Cost through Dec 31, 2016 (thousands of dollars)
Air Force-Active	Sheppard AFB	Texas	$790.7	$0.0	$790.7
Air Force-ANG	Sioux Gateway (Sioux City)	Iowa	$115.7	$0.0	$115.7
Air Force-ANG	Sky Harbor International Airport	Arizona	$91.7	$0.0	$91.7
Air Force-ANG	Springfield Municipal (Capital)	Illinois	$7.7	$0.0	$7.7
Air Force-ANG	Springfield-Beckley Municipal	Ohio	$151.7	$0.0	$151.7
Air Force-ANG	Standiford Field Air National Guard	Kentucky	$91.7	$0.0	$91.7
Air Force-ANG	Stanly/Badin County Airport Air National Guard Base	North Carolina	$31.7	$0.0	$31.7
Air Force-ANG	Stewart International Airport	New York	$163.7	$0.0	$163.7
Air Force-Active	Tinker AFB	Oklahoma	$816.1	$0.0	$816.1
Air Force-ANG	Toledo Express	Ohio	$151.7	$0.0	$151.7
Air Force-Active	Travis AFB	California	$816.1	$0.0	$816.1
Air Force-ANG	Truax Field	Wisconsin	$115.7	$0.0	$115.7
Air Force-ANG	Tucson International Airport	Arizona	$187.7	$0.0	$187.7
Air Force-ANG	Tulsa International Airport	Oklahoma	$91.7	$0.0	$91.7
Air Force-Active	Tyndall AFB	Florida	$392.9	$0.0	$392.9
Air Force-Active	USAF Academy	Colorado	$81.4	$0.0	$81.4
Air Force-Active	Vance AFB/Kegelman	Oklahoma	$790.7	$0.0	$790.7
Air Force-Active	Vandenberg AFB	California	$790.7	$0.0	$790.7
Air Force-ANG	Volk Field	Wisconsin	$107.9	$0.0	$107.9
Air Force-Active	Wake Island	Guam	$81.4	$0.0	$81.4
Air Force-Active	Westover Air Reserve Base	Massachusetts	$392.9	$0.0	$392.9
Air Force-Active	Whiteman AFB	Missouri	$439.3	$0.0	$439.3
Air Force-ANG	Will Rogers International Airport	Oklahoma	$115.7	$0.0	$115.7
Air Force-BRAC	Williams AFB	Arizona	$1,089.0	$0.0	$1,089.0
Air Force-ANG	WK Kellogg	Michigan	$163.7	$0.0	$163.7
Air Force-Active	Wright Patterson AFB	Ohio	$503.3	$2,805.6	$3,308.9
Air Force-BRAC	Wurtsmith AFB	Michigan	$2,079.7	$3,000.0	$5,079.7
Air Force-ANG	Yeager (McLaughlin)	West Virginia	$103.7	$0.0	$103.7
Air Force-Active	Youngstown Air Reserve Station	Ohio	$81.4	$0.0	$81.4
		Air Force Subtotals:	**$119,712.1**	**$32,783.0**	**$152,495.1**

Appendix C: DoD Installations with a Known or Suspected Release of PFOS/PFOA

DoD Component	Installation Name	State/Territory	Investigation Costs[1] (thousands of dollars)	Cleanup Costs[2] (thousands of dollars)	Total Cost through Dec 31, 2016 (thousands of dollars)
DLA - Active	Defense Supply Center Richmond	Virginia	$0.0	$0.0	$0.0
DLA - Active	Susquehanna	Pennsylvania	$0.0	$0.0	$0.0
		DLA Subtotals:	**$0.0**	**$0.0**	**$0.0**
		Grand Totals:	**$141,798.1**	**$56,856.5**	**$198,654.6**

Footnotes:

1: Investigation costs include but are not limited to: site investigation work (e.g., preliminary assessments, site inspections, remedial investigations) and monitoring.

2: Cleanup costs include but are not limited to site restoration; corrective action (e.g., supplying bottled water, installing granular activated carbon filters).

3: This installation is not one of the 393 active and BRAC installations with one or more areas where there is a known or suspected release of PFOS or PFOA as of December 31, 2016; however, it is included here because DoD spent DERP funds to investigate for a potential release of PFOS or PFOA at the request of the regulator.

4: The Navy expended these funds to investigate known or suspected PFOS/PFOA releases at several BRAC installations.

5: The Navy plans, programs, budgets, and executes the Defense Environmental Restoration Program for the U.S. Marine Corps.

United States Government Accountability Office

Report to Congressional Committees

October 2017

DRINKING WATER

DOD Has Acted on Some Emerging Contaminants but Should Improve Internal Reporting on Regulatory Compliance

GAO-18-78

GAO Highlights

Highlights of GAO-18-78, a report to congressional committees

October 2017

DRINKING WATER

DOD Has Acted on Some Emerging Contaminants but Should Improve Internal Reporting on Regulatory Compliance

Why GAO Did This Study

According to DOD, about 3 million people in the United States receive drinking water from DOD public water systems, which are to comply with EPA and state health-based regulations. EPA and DOD have detected elevated levels of two unregulated, DOD-identified emerging contaminants found in firefighting foam—PFOS and PFOA—in drinking water at or near installations. Perchlorate, an unregulated chemical used by DOD in rocket fuel, can also be found in drinking water.

The Senate Report accompanying a bill for national defense authorization for fiscal year 2017 included a provision for GAO to review DOD management of drinking water contaminants. This report examines the extent to which DOD has (1) internally reported data on compliance with health-based drinking water regulations at military installations and used those data to assess compliance at its two types of public water systems, and (2) taken actions to address concerns with its firefighting foam and elevated levels of PFOS, PFOA, and perchlorate in drinking water at or near military installations. GAO reviewed DOD guidance and EPA drinking water regulations, advisories, and orders; analyzed DOD and EPA drinking water data; and visited seven installations from among those addressing emerging contaminants in drinking water.

What GAO Recommends

GAO is making five recommendations to improve DOD's reporting and use of data on compliance with health-based drinking water regulations. DOD concurred with the recommendations.

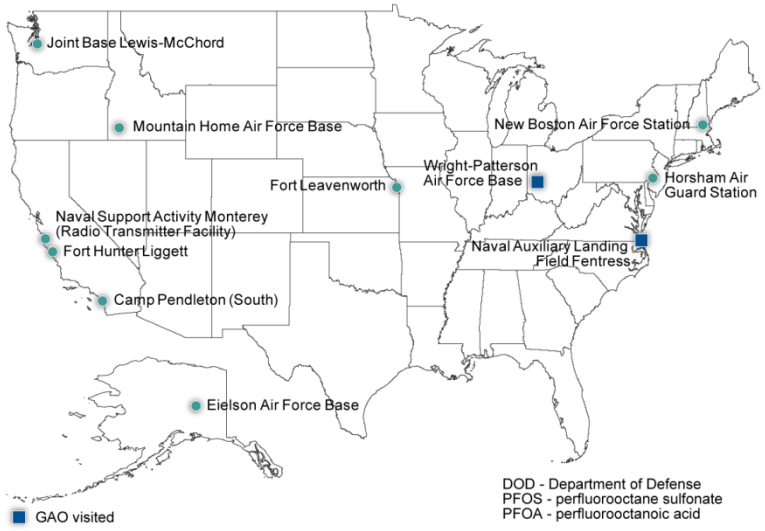
View GAO-18-78. For more information, contact J. Alfredo Gómez at (202) 512-3841 or gomezj@gao.gov or Brian Lepore at (202) 512-4523 or leporeb@gao.gov.

What GAO Found

The Department of Defense (DOD) has not internally reported all data on compliance with health-based drinking water regulations or used available data to assess compliance. DOD data for fiscal years 2013-2015 indicate that DOD public water systems complied with Environmental Protection Agency (EPA) and state health-based drinking water regulations at levels comparable with other systems in the United States. However, the military departments did not report all violations to DOD, i.e., while 77 installations reported violations to DOD, GAO found that at least 16 additional installations did not. Until DOD takes steps to increase the clarity and understanding of its internal reporting requirements, it may not have the data it needs to fully oversee compliance. DOD also has not used its data to determine why its two types of systems—one that provides DOD-treated water and another that provides non-DOD-treated water—have different compliance rates. Specifically, DOD's data indicate that about 99 percent of the people who received non-DOD-treated drinking water were served by systems with no violations, while about 89 percent of the people who received DOD-treated drinking water were served by systems with no violations. Absent further analysis of its data, DOD may not be able to improve overall compliance.

DOD has initiated actions to address concerns with both its firefighting foam and also with elevated levels in drinking water of perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), and perchlorate, which are DOD-identified emerging contaminants. PFOS and PFOA can be found in DOD's firefighting foam. DOD has restricted its use of this foam and is funding efforts to develop a new foam that meets DOD performance requirements. Additionally, at 11 military installations (see fig.), DOD has shut down wells, provided alternate water sources, or installed water treatment systems to respond to elevated levels of PFOS and PFOA, at times in response to EPA and state orders.

Military Installations Where DOD Has Initiated Actions to Address Elevated Levels of PFOS and PFOA in Installation Drinking Water, as of March 2017



Sources: GAO analysis of DOD data; Map Resources (map) | GAO-18-78

Contents

Figures

Abbreviations

ASD (EI&E)	Assistant Secretary of Defense for Energy, Installations, and Environment
DOD	Department of Defense
EPA	Environmental Protection Agency
PFCs	perfluorinated chemicals
PFOS	perfluorooctane sulfonate
PFOA	perfluorooctanoic acid

U.S. GOVERNMENT ACCOUNTABILITY OFFICE
441 G St. N.W.
Washington, DC 20548

October 18, 2017

Congressional Committees

Every year about 3 million people who live and work on military installations in the United States receive drinking water from a Department of Defense (DOD) public water system, according to the department.[1] These people are served by two different types of public water systems. Specifically, about two-thirds of these people are provided DOD-treated drinking water, and about one-third are provided non-DOD-treated drinking water—that is, drinking water from DOD systems that have been privatized or that obtain treated drinking water from a local utility.[2] DOD's public water systems, like all public water systems, are required to comply with legally enforceable drinking water regulations that are issued by the Environmental Protection Agency (EPA) under the Safe Drinking Water Act, as well as with any additional regulations issued by state environmental agencies.[3] DOD policy also requires the military departments to report annually on compliance with health-based regulations at their installations' public water systems to the Assistant Secretary of Defense for Energy, Installations, and Environment (ASD (EI&E)) within the Office of the Secretary of Defense.[4]

[1]The term "public water system" refers to the provision of piped drinking water to the public, where the system serves at least 15 service connections or serves an average of at least 25 people at least 60 days out of the year; it does not refer to whether the system is publicly or privately owned.

[2]DOD does not provide any additional treatment to non-DOD-treated drinking water. Drinking water treatment generally consists of filtration, sedimentation, and other processes to remove impurities and harmful agents, and disinfection processes such as chlorination to eliminate biological contaminants.

[3]Pub. L. No. 93-523 (1974), *codified as amended at* 42 U.S.C. §§ 300f-300j-26. The Safe Drinking Water Act requires EPA to establish legally enforceable standards for public water systems that generally limit the levels of specific contaminants in drinking water that can adversely affect public health.

[4]DOD Instruction 4715.06, *Environmental Compliance in the United States* (May 4, 2015). The instruction describes health-based drinking water standards as those standards that must be met or there may be health-based risks. The standards used by DOD are those of the National Primary Drinking Water Regulations or equivalent state or local regulations having a prescribed maximum contaminant level, maximum residual disinfectant level, or treatment technique.

In May 2016, EPA issued a drinking water health advisory—nonenforceable technical guidance—for perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA), which are part of a larger group of manufactured compounds called perfluorinated chemicals (PFCs) and can be found in firefighting foam used by DOD since the 1970s.[5] PFCs are widely used to make everyday products more resistant to stains, grease, and water, such as by keeping food from sticking to cookware and making clothes and mattresses more waterproof. According to the Agency for Toxic Substances and Disease Registry, exposure to elevated levels of PFOS and PFOA could cause increased cancer risk and other health issues in humans. EPA and DOD have detected elevated levels of PFOS and PFOA in drinking water at or near DOD installations, and EPA has also found these chemicals in drinking water at non-DOD public water systems across the United States.

DOD has included PFOS and PFOA on its list of emerging contaminants. DOD defines emerging contaminants as chemicals or materials that the department currently uses or plans to use that present a potentially unacceptable human health or environmental risk; have a reasonably possible pathway to enter the environment; and either do not have regulatory standards based on peer-reviewed science, or their regulatory standards are evolving due to new science, detection capabilities, or pathways.[6] DOD has also included perchlorate, which is a chemical that DOD uses in rocket fuel, on its list of emerging contaminants. Like PFOS and PFOA, perchlorate has not been regulated by EPA under the Safe Drinking Water Act but does have an EPA-issued interim drinking water health advisory.[7] Overall, DOD's list of emerging contaminants includes

[5]EPA, *Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS)* (May 2016); EPA, *Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA)* (May 2016). PFCs can also be referred to as per- and polyfluoroalkyl substances, or PFASs. EPA explains that health advisories provide information on contaminants that can cause human health effects and are known or anticipated to occur in drinking water. The advisories are nonenforceable and nonregulatory and provide technical information to drinking water system managers and others with primary responsibility for overseeing the water systems with information on the health risk of identified, but unregulated, chemicals.

[6]DOD Instruction 4715.18, *Emerging Contaminants* (June 11, 2009).

[7]In 2011, EPA determined that perchlorate meets the criteria for regulating a contaminant in the Safe Drinking Water Act. *Drinking Water: Regulatory Determination on Perchlorate*, 76 Fed. Reg. 7762 (February 11, 2011). Since that time, an initial peer review has been completed for the Perchlorate Biologically Based Dose Response model and model report. According to EPA officials, a proposed regulation for perchlorate is expected by October 2018, with a final regulation approved by December 2019. Additionally, EPA has established guidance on cleanup levels for perchlorate.

21 contaminants that can be found in drinking water: 10 that have been regulated by EPA under the Safe Drinking Water Act and 11 that are currently unregulated but have an EPA-issued drinking water health advisory.

Senate Report 114-255 accompanying a bill for national defense authorization for fiscal year 2017 included a provision for us to review DOD's efforts to manage contaminants in drinking water. This report examines the extent to which DOD has (1) internally reported data on compliance with health-based drinking water regulations at military installations and used those data to assess compliance at its two types of public water systems and (2) taken actions to address concerns with its firefighting foam containing PFCs and elevated levels of PFOS, PFOA, and perchlorate in drinking water at or near military installations.

For objective one, we analyzed data reported by the military departments to ASD (EI&E) on compliance with and violations of health-based drinking water regulations at DOD public water systems for fiscal years 2013 through 2015 (the most recent data available at the time of our review). We compared data from EPA's Safe Drinking Water Information System for the same time frame to determine the extent to which violations recorded in the EPA system were also reported by the military departments to ASD (EI&E).[8] We also analyzed the data to identify any differences in violations between DOD- and non-DOD-treated drinking water. We assessed the reliability of the DOD and EPA data on violations of health-based drinking water regulations by reviewing relevant documentation, testing the data for obvious errors, and interviewing knowledgeable officials. As we have previously found, EPA's data system may not contain all public water system violations because states have generally under-reported violations.[9] During this review, we also found

[8]States collect and manage relevant data (including violations and enforcement information) in either a database provided by EPA—known as the Safe Drinking Water Information System/State—or in a data system of their own design. The states also periodically transfer from their database information on violations and enforcement actions to the EPA headquarters version of the Safe Drinking Water Information System (known as Safe Drinking Water Information System/Federal). EPA generally uses the data in its version of the system—along with other documentation provided on request—to review state determinations of when water systems are complying with the act. EPA also uses these data to determine whether water systems, in the aggregate, are achieving the agency's national targets for compliance.

[9]GAO, *Drinking Water: Unreliable State Data Limit EPA's Ability to Target Enforcement Priorities and Communicate Water Systems' Performance*, GAO-11-381 (Washington, D.C.: June 17, 2011).

that some public water system identification numbers for DOD installations could not be matched with EPA's data system and, therefore, these identification numbers were excluded from our analysis.[10] As a result, some DOD installation violations may be missing from the data, and we may not have comprehensive violations data for health-based drinking water regulations at DOD installations. Nonetheless, we determined that DOD and EPA data were sufficiently reliable for the purposes of identifying whether any drinking water violations were recorded in EPA's system but not internally reported within DOD, as well as to indicate possible differences in reported violations for DOD's two types of public water systems. We evaluated the military departments' reported data and DOD's use of these data to determine compliance with DOD's reporting requirements as defined by DOD's environmental compliance instruction[11] and with *Standards for Internal Control in the Federal Government*. According to these standards, quality information is needed to achieve an organization's objectives, management is to monitor performance over time and promptly resolve any findings, and actions such as improved communication to and additional training for personnel are helpful for an organization to meet its objectives.[12] We also discussed our analysis with ASD (EI&E) and military department officials.

For objective two, we reviewed DOD policies on and requirements for firefighting foam, as well as documents related to the research and development of a PFC-free firefighting foam. We also interviewed military department and installation officials to discuss DOD actions regarding current and future use of firefighting foam. Additionally, we reviewed administrative orders issued by EPA and one state regulator (Ohio) directing DOD to address elevated levels of PFOS and PFOA, and we interviewed officials from the EPA regions (1 and 3) and the state (Ohio) that issued those orders, as well as DOD officials responsible for responding to those orders.[13] We also reviewed drinking water guidance documents from ASD (EI&E) and the military departments on PFOS,

[10]We were able to match 440 public water systems that serve DOD installations to EPA's data and not able to match 296 systems.

[11]DOD Instruction 4715.06.

[12]GAO, *Standards for Internal Control in the Federal Government*, GAO-14-704G (Washington, D.C.: September 2014).

[13]EPA has 10 regions in the United States, each responsible for carrying out EPA programs within several states and territories.

PFOA, and perchlorate[14] and obtained DOD data as of December 2016 (the most recent data available at the time of our review) on testing and response activities for those contaminants. We assessed the reliability of the data by examining the data for obvious errors and inconsistencies; comparing the data, where applicable, with other information collected; and interviewing knowledgeable officials. We found the data to be sufficiently reliable for our purposes of describing DOD-reported actions and costs for addressing PFOS and PFOA. To obtain additional information on DOD actions to address emerging contaminants, we visited at least two installations per military department—seven installations total—that we selected because DOD was investigating or responding to unregulated DOD-identified emerging contaminants in drinking water at those installations.[15] We provide further details on our scope and methodology in appendix I.

We conducted this performance audit from June 2016 to October 2017 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

DOD Public Water Systems

DOD has two types of public water systems that provide drinking water to people that live and work on military installations. The first type provides drinking water that has been treated by DOD. The second type provides water treated by a private company or a local utility, which we refer to as "non-DOD-treated" drinking water. Drinking water systems vary by size and other factors, but they most typically include a supply source, treatment facility, and distribution system. A water system's supply source may be a reservoir, aquifer, well, or a combination of these sources. The

[14]These are the only unregulated DOD-identified emerging contaminants for which DOD has issued such guidance.

[15]We visited Fort Carson, Colorado, and Fort Jackson, South Carolina (Army); former Naval Air Station Joint Reserve Base Willow Grove, Pennsylvania, and Naval Auxiliary Landing Field Fentress, Virginia (Navy); Joint Base Langley-Eustis, Virginia, Peterson Air Force Base, Colorado, and Wright-Patterson Air Force Base, Ohio (Air Force).

treatment process for surface water generally uses sedimentation, filtration, and other processes to remove impurities and harmful agents, and disinfection processes such as chlorination to eliminate biological contaminants. Distribution systems are comprised of water towers, piping grids, pumps, and other components to deliver treated water from treatment systems to consumers.

Drinking Water Regulations and Administrative Orders

EPA regulates drinking water contaminants under the Safe Drinking Water Act by issuing legally enforceable standards, known as National Primary Drinking Water Regulations, which generally limit the levels of these contaminants in public water systems. EPA has issued such regulations for approximately 90 drinking water contaminants. In accordance with the Safe Drinking Water Act, EPA may authorize a state to have primary enforcement responsibility for drinking water regulations, as long as the state has, among other things, drinking water regulations that are no less stringent than the National Primary Drinking Water Regulations.[16]

The Safe Drinking Water Act also authorizes EPA to take emergency actions necessary to protect public health when informed that a contaminant is present in or is likely to enter a public water system or an underground source of drinking water that may present an imminent and substantial endangerment.[17] For example, EPA may issue administrative orders, which generally include actions to be taken, such as remediating contaminated sources of drinking water or requiring the provision of alternative water supplies. State regulators may also issue orders to public water systems to address contaminated drinking water.

Public water systems, including the DOD public water systems that provide drinking water to about 3 million people living and working on military installations, are required to comply with EPA and state drinking water regulations.[18] EPA divides violations of drinking water regulations

[16]42 U.S.C. § 300g-2(a)(1).

[17]EPA may do so if appropriate state and local authorities have not acted to protect human health. 42 U.S.C. § 300i.

[18]ASD (EI&E) tracks the number of people served by DOD public water systems. ASD (EI&E) does not track the number of DOD public water systems but estimates that there are approximately 450 installations in the United States.

into two types: (1) health-based violations[19] and (2) other types of violations that include violations of monitoring, reporting, and public notification requirements.[20] Under the Safe Drinking Water Act, EPA also is required to identify unregulated contaminants that present the greatest health concern, establish a program to monitor drinking water for unregulated contaminants, and decide whether or not to regulate at least five such contaminants every 5 years.[21] EPA has not regulated any new contaminants using this process since 1996.[22]

DOD's environmental compliance policy states that ASD (EI&E) is responsible for providing guidance, oversight, advocacy, and representation for environmental compliance programs—to include overseeing the military departments' compliance with health-based drinking water regulations at DOD public water systems.[23] The policy directs the military departments to annually report to ASD (EI&E) the total population receiving water from both "regulated" and "other" DOD public water systems—referred to in this report as DOD public water systems that provide DOD- and non-DOD-treated drinking water, respectively—that did and did not attain all Safe Drinking Water Act health-based drinking water standards.[24] The policy also requires the military departments to report information regarding each instance health-based drinking water standards were not attained during the reporting period, to

[19]These occur when a contaminant level exceeds an EPA or state maximum limit, or when there is a violation of a prescribed treatment technique (which is an enforceable procedure or level of technological performance that public water systems must follow to ensure control of a contaminant).

[20]These occur when a system fails to: report monitoring results, notify the public about the occurrence of a monitoring violation, or provide customers with an annual Consumer Confidence Report containing data on the presence and concentrations of regulated contaminants.

[21]EPA decisions about whether or not to regulate these contaminants are called regulatory determinations. EPA completed three cycles of regulatory determinations for a total of 24 contaminants in 2003, 2008, and 2016, deciding not to regulate any of the contaminants. In 2011, EPA decided to regulate perchlorate outside of the regular cycle of regulatory determinations.

[22]We reported on these EPA activities in *Drinking Water: EPA Has Improved Its Unregulated Contaminant Monitoring Program, but Additional Action Is Needed,* GAO-14-103 (Washington, D.C.: Jan. 9, 2014).

[23]DOD Instruction 4715.06.

[24]According to DOD officials, the public water system operator that provides non-DOD treated drinking water is responsible for complying with EPA drinking water regulations.

include the name and location of the military installation; the nature of the issue (e.g., the contaminant type); the DOD population affected; the duration of the issue; the corrective actions taken or planned (e.g., flushing the system, resampling the water, or implementing system upgrades);[25] and the estimated date for achieving the standard.

EPA Health Advisories

In addition to issuing drinking water regulations, EPA may also publish drinking water health advisories. In contrast to drinking water regulations, health advisories are nonenforceable. Drinking water health advisories provide technical guidance on health effects, analytical methodologies, and treatment technologies. These advisories recommend the amount of these contaminants that can be present in drinking water—"health advisory levels"—at which adverse health effects are not anticipated to occur over specific exposure durations, to include 1 day, 10 days, several years, or over a lifetime. EPA issues provisional health advisories to provide information in response to an urgent or rapidly developing situation.[26] DOD's list of emerging contaminants includes 11 contaminants, including PFOS, PFOA, and perchlorate, for which EPA has issued a drinking water health advisory. Specifically,

- **PFOS.** PFOS is part of a larger group of fluorinated organic chemicals that have been incorporated into an array of consumer products (i.e., to make some more resistant to stains, grease, and water) and also in firefighting foam used by DOD and civilian airports. According to EPA, the major manufacturer of PFOS in the United States voluntarily agreed to phase out production of the chemical in 2002. According to EPA's health advisory, exposure to PFOS may remain possible due to legacy uses, existing and legacy use in imported goods, and the chemical's "extremely high persistence" in the environment. According to the EPA, exposure to PFOS may result in adverse health effects, such as fetal developmental effects during pregnancy or to breastfed infants, cancer, liver damage, immune effects, thyroid effects, and

[25]The purpose of flushing is to remove the water along with deposits, sediment, and other material that may be in the system's interior plumbing.

[26]Provisional health advisory levels reflect EPA's determination of reasonable, health-based hazard concentrations above which action should be taken to reduce exposure to unregulated contaminants in drinking water. EPA updates them as additional information becomes available and can be evaluated.

other effects.[27] See table 1 for details of the EPA provisional health advisory that was issued in 2009 and the lifetime health advisory that was issued in 2016, which superseded the provisional health advisory.

- **PFOA.** PFOA is a fluorinated organic chemical that has been used in generally the same products as PFOS, including firefighting foam used by DOD and civilian airports. According to EPA, PFOA was voluntarily phased out by eight major companies in the manufacturing of their products at the end of 2015. According to the EPA, adverse health effects from exposure to PFOA are similar to those for PFOS.[28] See table 1 for details of the EPA provisional health advisory that was issued in 2009 and the lifetime health advisory that was issued in 2016, which superseded the provisional health advisory.

[27]PFOS does not occur naturally in the environment and in the past PFOS was used mainly as grease, oil, and water resistance on materials such as textiles, carpets, paper, and as a general coating. In addition, it has also been used in firefighting foams. According to EPA, PFOS is extremely persistent in the environment and can be transported long distances in the air. The toxicity and bioaccumulation potential of PFOS indicate a cause of concern for the environment and human health. Companies have stopped production or have begun changing manufacturing practices to reduce releases and the amounts of these chemicals in their products. According to the Agency for Toxic Substances and Disease Registry, a large number of human studies have examined the possible relationships between levels of PFOS in blood and adverse health effects. It is difficult to interpret these results because they are not consistent; some studies have found an effect and others have not found the same effect.

[28]PFOA does not occur naturally in the environment and in the past has been used to make coatings and products that resist heat, oil, stains, grease, and water. According to the Centers for Disease Control and Prevention, people are most likely exposed to PFOA by drinking contaminated water sources, and possibly by using products that contain PFOA. The toxicity and bioaccumulation potential of PFOA indicate a cause of concern for the environment and human health. According to the Agency for Toxic Substances and Disease Registry, a large number of human studies have examined possible relationships between levels of PFOA in blood and adverse health effects. It is difficult to interpret these results because they are not consistent; some studies have found an effect and others have not found the same effect.

Table 1: Environmental Protection Agency (EPA) Drinking Water Health Advisory Levels for Perfluorooctane Sulfonate (PFOS) and Perfluorooctanoic Acid (PFOA)

	EPA provisional health advisory levels (January 2009)	EPA lifetime health advisory levels (May 2016)
PFOS	200 parts per trillion in drinking water for short-term exposure of weeks to months	70 parts per trillion for lifetime exposure (which EPA estimates to be approximately 70 years) Combined PFOS and PFOA level of 70 parts per trillion
PFOA	400 parts per trillion in drinking water for short-term exposure of weeks to months	70 parts per trillion for lifetime exposure (which EPA estimates to be approximately 70 years) Combined PFOS and PFOA level of 70 parts per trillion

Source: EPA. | GAO-18-78

Note: One part per trillion is comparable to one drop in a swimming pool covering the area of a football field 43 feet deep. The January 2009 provisional health advisory levels for PFOS and PFOA were superseded by the May 2016 lifetime health advisory levels. EPA developed the provisional health advisories to reflect an amount of PFOS or PFOA that could cause adverse health effects in the short term (i.e., weeks to months). The provisional health advisories were intended as a guideline while allowing time for EPA to develop lifetime health advisories.

- **Perchlorate.** Perchlorate is commonly used in solid propellants, fireworks, matches, signal flares, and some fertilizers, and has been used by DOD for rocket fuel and ammunition. EPA published an interim health advisory for perchlorate in 2008; the interim health advisory level was set at 15 parts per billion. According to the health advisory, perchlorate can disrupt the functions of the thyroid gland.[29]

DOD-Identified Emerging Contaminants

In 2009, DOD issued a policy on the identification, assessment, and risk management of emerging contaminants that have the potential to impact DOD.[30] According to that policy, chemicals and materials used or planned for use by DOD that meet the definition of an emerging contaminant

[29]Perchlorate occurs naturally in the southwestern region of the United States and can also be manufactured as colorless, odorless salts that are highly soluble in water. The most manufactured perchlorate salt is ammonium perchlorate and the most common uses of it are in rocket propellant, military motors, grenades, and solid rocket fuel. Perchlorate also has a range of commercial uses in fireworks, matches, automobile batteries and air bags, and fertilizers. Exposure to perchlorate can come from ingested food and contaminated drinking water, and can impact normal growth and the development of the central nervous system in fetuses and infants through the reduction of thyroid hormone production or hypothyroidism.

[30] DOD Instruction 4715.18.

should be identified as early as possible. The policy further states that DOD is to assess and, when appropriate, take action to reduce risks posed by its emerging contaminants to people; the environment; and DOD missions, programs, and resources. Where necessary, DOD is to perform sampling, conduct site-specific risk assessments, and take response actions for emerging contaminants released from DOD facilities, in accordance with relevant statutes.

According to the DOD policy on emerging contaminants, ASD (EI&E) is to develop and maintain a list of emerging contaminants with potential or probable high risk to the department's personnel and functions. As of April 2017, DOD's list of emerging contaminants comprised 49 chemicals or substances. According to our analysis of EPA documents, DOD's list includes 21 contaminants that can be found in drinking water. Of these 21 contaminants, 10 contaminants have been regulated by EPA under the Safe Drinking Water Act, and 11 contaminants are currently unregulated but have an EPA-issued drinking water health advisory. The other 28 DOD-identified emerging contaminants do not have EPA drinking water regulations or health advisories. Appendix II provides more information on the drinking water regulatory status of DOD-identified emerging contaminants.

DOD Has Not Internally Reported All Data on Compliance with Drinking Water Regulations or Used Available Data to Evaluate Differences between Its Drinking Water Systems

For the years we reviewed—fiscal years 2013 through 2015—the military departments annually reported information internally to ASD (EI&E) on compliance with EPA and state health-based drinking water regulations, which indicate that drinking water quality at DOD public water systems was similar to other systems in the United States. However, not all violations of health-based regulations were reported to ASD (EI&E) during this time frame, as is required by DOD policy. The military departments reported that a total of 77 military installations had at least one violation at some point from fiscal year 2013 through fiscal year 2015, but we found that at least 16 additional installations had violations that were reported to EPA but were not internally reported to ASD (EI&E). DOD also has not used available compliance data to identify why DOD public water systems that provide DOD-treated drinking water appear to have more violations of health-based regulations than DOD systems that provide non-DOD-treated drinking water.

Military Departments Have Internally Reported Data on Compliance with Health-Based Drinking Water Regulations, but Have Not Reported All Violations

For the years we reviewed—fiscal years 2013 through 2015—the military departments annually reported information to ASD (EI&E) on compliance with and violations of EPA and state health-based drinking water regulations at the DOD public water systems that provide drinking water to military installations. The military departments' data for fiscal years 2013 through 2015 indicate that about 92 percent of people who received drinking water from DOD public water systems were served by a system that complied with EPA and state health-based regulations. This is similar to the percentage of people in the United States—also about 92 percent, according to EPA—who received drinking water during that time frame from a community public water system with no health-based violations.[31] The data for that time period also indicate that about 8 percent of people were provided drinking water from a DOD public water system that had at least one violation of a health-based regulation. Health-based violations can be for any length of time during a fiscal year—for example, a violation lasting 1 day is counted the same as a violation lasting for 1 month.[32] Across the 3 fiscal years, the military departments reported that a total of 77 military installations had at least one violation at some point during that time period: 35 in fiscal year 2013, 25 in fiscal year 2014, and 17 in fiscal year 2015. The most common types of contaminants for which the military departments reported violations were coliform[33] and two disinfection byproducts—trihalomethanes and haloacetic acids[34]—which, according to

[31]Community water systems are public water systems that provide drinking water to the same population year-round. According to the EPA, community water systems provided drinking water to more than 300 million people in the United States in fiscal year 2015—about 94 percent of the total population. The military departments are to report violations for all types of public water systems, which would include community water systems.

[32]The EPA uses this same approach when calculating the number of people who receive drinking water from a community water system with no violations of health-based regulations.

[33]Total coliforms are a group of related bacteria that are (with few exceptions) not harmful to humans. A variety of bacteria, parasites, and viruses, known as pathogens, can potentially cause health problems if humans ingest them. EPA considers total coliforms a useful indicator of other pathogens for drinking water and they are used to determine the adequacy of water treatment and the integrity of the distribution system.

[34]Disinfection is usually a chemical process used in water systems where chemicals are added to inactivate (or kill) pathogens found in the source water. Disinfection through inactivation usually involves the use of disinfectants such as chlorine or other chemicals, and a combination of chlorine and ammonia that may render many of these pathogens harmless. Disinfection byproducts are formed when disinfectants used in a water treatment react with bromide and/or natural organic matter (e.g., decaying vegetation) that is present in the source water. In addition, different disinfectants produce different types or amounts of disinfection byproducts.

EPA, are among the most common types of contaminants for which health-based drinking water violations occur across the United States.

However, we found that the military departments have not always reported all violations to ASD (EI&E), as required by DOD policy.[35] Based on our review of data in EPA's Safe Drinking Water Information System for fiscal years 2013 through 2015, we found that the military departments did not report violations to ASD (EI&E) for at least 16 installations—9 Air Force installations, 5 Navy installations, and 2 Army installations.[36] According to EPA's database, the total population served by DOD public water systems at these installations is approximately 180,000 people, and most of the violations that went unreported involved coliform and disinfection byproduct contaminants. However, the actual population number affected by these violations and the contaminants involved—along with other information such as the duration of the contamination and the corrective actions planned or taken—were not included in the military departments' annual reports to ASD (EI&E). These violations were recorded in EPA's system, which indicates that the installations reported the violations to the appropriate state regulatory agencies, who then reported them to EPA's database. However, the violations were not reported to ASD (EI&E), as required by DOD policy.

According to military department officials, violations of health-based drinking water regulations went unreported to ASD (EI&E) due to a lack of clarity in DOD's reporting requirements and misunderstandings of the requirements on the part of installations and the military departments. We found that violations were either not reported by the military installations where the violations occurred or that they were not reported by the installations' chains of command.[37] Navy officials cited turnover of

[35]DOD Instruction 4715.06.

[36]It is possible that additional installations did not report violations of health-based drinking water regulations to ASD (EI&E). We found that some public water system identification numbers for DOD installations could not be matched with EPA's Safe Drinking Water Information System and, therefore, were not included in our analysis. Additionally, as we previously found in 2011, EPA's system may not contain all public water violations as states have under-reported violations in the past. We found the data sufficiently reliable to indicate a minimum number of installation violations that were not reported to ASD (EI&E). See GAO-11-381 for additional information.

[37]Each year, personnel at military installations are instructed by the military departments to report any violations of health-based regulations through the installations' chain of command to the military departments' respective headquarters, and the military departments' headquarters are to report those violations to ASD (EI&E).

installation personnel as the reason some violations went unreported, as well as misinterpretations by installation personnel of DOD's reporting requirements. Air Force officials also told us that most of their unreported violations were not reported to ASD (EI&E) because the Air Force did not interpret them as health-based violations, although DOD policy requires these types of violations to be reported.[38] Army officials told us that, based on their interpretation of DOD's policy, the policy did not require them to report violations at installations where formal, written notification was not received from the state regulatory agency. However, ASD (EI&E) officials stated that all violations of health-based regulations should be reported, whether or not the state provides formal, written notification of the violation. Navy officials also told us that they have not reported violations at some of the Navy's smaller systems that purchase drinking water from non-DOD public water systems, due in part to misinterpretation of DOD's internal reporting requirements. However, Navy officials told us that ASD (EI&E) had instructed them to begin reporting these types of violations in fiscal year 2016, and the Navy is working with ASD (EI&E) and the other military departments to determine whether these types of systems should regularly report health-based violations.

Currently, ASD (EI&E) does not have complete data in accordance with DOD's policy, limiting its ability to conduct oversight and analyze how many people at military installations receive drinking water with health-based violations, what contaminants were involved, the duration of the contamination, or what corrective actions the military departments have planned or taken to address the violation. *Standards for Internal Control in the Federal Government* states that quality information is needed to achieve an organization's objectives. Those standards also indicate that actions such as improved communication to and additional training for personnel are helpful for an organization to meet its objectives.[39] According to DOD officials, a committee comprised of ASD (EI&E) and military department officials began a review in 2016 of DOD's internal reporting requirements for drinking water compliance data. While such a

[38]According to Air Force officials, the Air Force based its decision on EPA's Revised Total Coliform Rule, which was issued in February 2013, and made changes to the EPA's existing Total Coliform Rule's maximum contaminant levels for coliform. However, the compliance date for the new rule requirements was April 1, 2016, and Air Force officials acknowledged that the coliform violations we identified occurred before the new rule went into effect and should have been reported to ASD (EI&E).

[39]GAO-14-704G .

committee could be in a position to make recommendations on clarifying the annual reporting requirements, no documentation on the committee's efforts was yet available at the time of our review as the committee's work was still in progress. In addition, at present, there are no firm dates for when its work will be completed or when any potential changes would be implemented. Absent actions by ASD (EI&E) to identify and implement any necessary changes to clarify annual reporting requirements in its environmental compliance policy, and absent actions by the military departments to increase understanding at their installations and commands about the requirements, adherence to DOD's environmental compliance policy will remain limited and DOD will lack complete data to conduct oversight of regulatory compliance at its public water systems.

DOD Has Not Used Available Data to Assess Why DOD-Treated Water Appears to Have More Health-Based Violations Than Non-DOD-Treated Drinking Water

DOD has not used available data to assess why DOD public water systems providing DOD-treated drinking water appear to have more violations of health-based drinking water regulations than systems providing non-DOD-treated drinking water. Although we found that not all violations were reported by the military departments to ASD (EI&E), the data that were reported during fiscal years 2013 through 2015 indicated that about 99 percent of the people who received non-DOD-treated drinking water were served by systems with no violations, while about 89 percent of the people who received DOD-treated drinking water were served by systems with no violations.[40]

When we asked ASD (EI&E) and military department officials why these differences may exist, they were unable to provide an explanation because they had not used the reported water quality data to identify the reasons why DOD public water systems providing DOD-treated water appear to have more violations than systems providing non-DOD-treated water. Although some officials offered ideas on the reasons for differences in compliance—including the relative expertise of utilities and private companies, versus DOD, in providing drinking water—DOD officials acknowledged that the agency has not evaluated the data to identify specific reasons for why the differences may exist. All public water systems, including DOD public water systems, are required to comply with applicable EPA and state drinking water regulations. According to *Standards for Internal Control in the Federal Government,*

[40]According to EPA data for this time period, about 92 percent of people who received drinking water from community water systems across the United States were served by systems with no violations.

management should establish and operate activities to monitor the internal control system and evaluate the results. Such monitoring should assess the quality of performance over time and promptly resolve any findings.[41] Without reviewing the data reported by the military departments to identify why there appear to be differences in violations between DOD's two types of public water systems and without identifying and implementing any actions to address any differences, ASD (EI&E) and the military departments may not be able to improve overall compliance with health-based drinking water regulations.

DOD Has Initiated Actions to Address Concerns with Its Firefighting Foam as Well as Elevated Levels of PFOS, PFOA, and Perchlorate in Drinking Water

DOD is taking steps to address health and environmental concerns with its use of firefighting foam that contains PFCs—including PFOS and PFOA—to include restricting the use of foam at its installations and funding research into the development of a PFC-free foam that can meet DOD performance requirements. DOD also has responded to EPA and state orders and initiated additional actions to address elevated levels of PFOS, PFOA, and perchlorate.

[41]GAO-14-704G.

DOD Is Taking Steps to Address Health and Environmental Concerns with Firefighting Foam That Contains PFCs

DOD is taking steps to address PFOS- and PFOA-related health and environmental concerns with its use of firefighting foam that contains PFCs.[42] Firefighting foam is used by DOD to put fires out quickly while also ensuring that they do not reignite. This is critical if, for example, there is a fire from a fighter jet on the deck of an aircraft carrier. DOD has outlined performance requirements in its military specification for firefighting foam,[43] which was authored by the Navy's Naval Sea Systems Command but is approved for use in all of DOD.[44] For example, the military specification states how long it should take for firefighting foam to extinguish a fire—based on the size of the fire and the amount of foam used—and how long the foam should prevent the extinguished fire from reigniting.[45] DOD's military specification also requires that firefighting foam purchased and used by the department must contain PFCs.[46]

DOD's steps to address concerns with the use of firefighting foam include restricting the use of existing foams that contain PFCs; testing its current foams to identify the amount of PFCs they contain; and funding research into the future development of PFC-free foam that can meet DOD's performance and compatibility requirements (see table 2). Some of these steps, such as limiting the use of firefighting foam containing PFCs, are in place. Others, such as determining the specific amount of PFCs in existing firefighting foams or researching potential PFC-free firefighting

[42]Firefighting foam used by DOD contains other types of PFCs in addition to PFOS and PFOA. Other types of PFCs include perfluorohexane sulfonic acid, perfluorohexanoic acid, and perfluorobutane sulfonic acid. To date, EPA has only issued health advisories for PFOS and PFOA.

[43]DOD, Mil-F-24385F*, Fire Extinguishing Agent, Aqueous Film Forming Foam (AFFF) Liquid Concentrate, for Fresh and Seawater* (Aug. 5, 1994). According to DOD, a specification is a document prepared to support acquisition that describes the essential technical requirements for purchased material and the criteria for determining whether those requirements are met.

[44]The Federal Aviation Administration also requires that airport operators purchase firefighting foam that meets DOD's military specification.

[45]Other requirements in the military specification include that firefighting foam, which is partially comprised of water, should be able to extinguish fires using both fresh and sea water, and that firefighting foam approved for use by DOD from one manufacturer must be compatible with firefighting foam from another manufacturer.

[46]The military specification states that firefighting foam concentrates shall consist of "fluorocarbon surfactants," which the Navy interprets as synonymous with PFCs.

foams, are in progress with targets, in some cases, but no firm completion dates.

Table 2: Department of Defense (DOD) Steps to Address Concerns about Perfluorooctane Sulfonate (PFOS) and Perfluorooctanoic Acid (PFOA) in Firefighting Foam

Step	Goal	Actions/status
Restrictions on use of firefighting foam	Following the May 2016 issuance of the Environmental Protection Agency's lifetime health advisory for PFOS and PFOA, the military departments issued policies restricting the use of firefighting foam at their installations.	Actions called for in military department policies: Air Force: Stop routine testing of firefighting equipment unless the released foam can be contained and managed. Treat all releases of firefighting foam with PFOS or PFOA as hazardous material releases.[a] Navy: Stop the uncontrolled release of firefighting foam except in emergency situations. Ensure that any foam that is discharged in a nonemergency situation is contained, captured, and properly disposed of.[b] Army: Prohibit all nonemergency discharges of firefighting foam, to include training and equipment testing.[c]
Testing firefighting foam with PFCs	DOD's intent is to eventually replace the existing firefighting foam that contains PFOS and PFOA.	According to DOD, firefighting foams approved for purchase and use by DOD since at least December 2015 does not contain PFOS, but these firefighting foams contain other types of PFCs and may contain PFOA. The Naval Research Laboratory is testing the different types of firefighting foam that are currently approved for purchase and use by DOD to determine the extent to which they contain PFOA and other types of PFCs.[d] Testing is expected to continue until late 2017 or 2018. Navy and Army officials said that they plan to wait for final testing results before deciding whether to select a specific firefighting foam to replace the foam used at their installations. The Air Force, however, has already selected a specific foam for use at its installations. This foam contains PFCs (per DOD's military specification) but, according to the Air Force, does not contain PFOS and contains little or no PFOA. Officials said that all Air Force installations in the continental United States had received this new foam.
Funding firefighting foam research	DOD is funding research into the development of PFC-free firefighting foam because DOD believes that such a foam would significantly reduce the environmental impact of fire suppression training and operations, while maintaining the safety of personnel from fire hazards.	In October 2015, DOD's Strategic Environmental Research and Development Program issued a statement of need calling for proposals to develop a PFC-free firefighting foam that can meet DOD's performance requirements and be compatible with existing foams and equipment. In fiscal year 2017, DOD selected for funding three research projects that responded to the statement of need—one led by the Naval Air Systems Command, one led by the Naval Research Laboratory, and one led by a private firefighting foam manufacturer—with an estimated total cost of $2.5 million and an estimated completion date of 2020.

Source: GAO analysis of DOD data. | GAO-18-78

[a]Office of the Assistant Secretary of the Air Force for Installations, Environment, and Energy Memorandum, *SAF/IE Policy on Perfluorinated Compounds (PFCs) of Concern* (Aug. 11, 2016).

[b]Office of the Assistant Secretary of the Navy for Energy, Installations, and Environment Memorandum, *Aqueous Film Forming Foam (AFFF) Control, Removal, and Disposal* (June 17, 2016).

[c]Assistant Chief of Staff of the Army for Installation Management Memorandum, *Limiting Use of Aqueous Film Forming Foam* (June 29, 2016).

[d]Navy officials told us they are testing the firefighting foam products that are currently included on DOD's qualified product list, which is the list of firefighting foams that have been approved for purchase and use by DOD.

Navy officials stated that they are planning to revise the military specification after they have completed their testing—to be completed in late 2017 or 2018—on the amounts of PFOS, PFOA, and other PFCs found in the firefighting foam currently used by DOD. That revision, according to Navy officials, is intended to set limits for the amount of PFCs that are allowed in firefighting foam. According to DOD, at present there is no PFC-free firefighting foam that meets DOD's performance and compatibility requirements. As a result, the Navy has no plans to remove the requirement for firefighting foam to contain PFCs at this time. However, if a PFC-free foam is developed in the future that can meet DOD performance and compatibility requirements, Navy officials said that any necessary revisions to the military specification would be made at that time—a process that could take months to complete.

DOD Has Responded to Orders from EPA and a State Regulator and Has Initiated Additional Actions to Address Elevated Levels of PFOS and PFOA in Drinking Water at or near Military Installations

DOD has taken steps to respond to four administrative orders directing the department to address PFOS and PFOA levels that exceeded EPA's health advisory levels for drinking water.[47] One order was issued by the Ohio Environmental Protection Agency at Wright-Patterson Air Force Base in Ohio, and three orders were issued by the EPA directed at: the former Pease Air Force Base in New Hampshire; Horsham Air Guard Station in Pennsylvania; and the former Naval Air Warfare Center Warminster in Pennsylvania. Under Section 1431 of the Safe Drinking Water Act, EPA may issue orders necessary to protect human health where a contaminant in a public water system presents an imminent and substantial endangerment. EPA may do so if appropriate state and local authorities have not acted to protect human health. These orders may require, among other things, carrying out cleanup studies, providing alternate water supplies, notifying the public of the emergency, and halting disposal of the contaminants threatening human health. The Ohio Environmental Protection Agency has similar authority.

According to information provided by officials from the Ohio Environmental Protection Agency, EPA, and DOD, DOD has taken steps to respond to the administrative orders. Table 3 provides further details on each order and examples of actions by DOD to address the orders.

[47]A "provisional" EPA health advisory for PFOS and PFOA was issued in January 2009 and was in effect until EPA issued a "lifetime" health advisory for PFOS and PFOA in May 2016. EPA defines a "lifetime" health advisory level as the exposure to a contaminant that can occur over a lifetime without adverse health effects.

Table 3: Department of Defense (DOD) Actions in Response to Administrative Orders for Perfluorooctane Sulfonate (PFOS) and Perfluorooctanoic Acid (PFOA) Drinking Water Contamination

Installation	Order date and issuing agency	Background on drinking water contamination with PFOS and PFOA[a]	Examples of actions by DOD
Wright-Patterson Air Force Base, Ohio	May 2016, Ohio's state Environmental Protection Agency	Levels of PFOS and PFOA that exceeded the Environmental Protection Agency's (EPA's) lifetime health advisory levels were found at two wells on the installation in 2016.	The Air Force • conducted additional sampling • closed specific drinking water wells and installed new monitoring wells • provided bottled water to vulnerable populations at the installation
Former Pease Air Force Base, New Hampshire[b]	July 2015, EPA	Levels of PFOS that exceeded EPA's provisional health advisory level were found at a public water supply well—there are now a commercial office park and two daycares at the former DOD installation.	The Air Force • is designing and constructing a treatment system for contaminated drinking water • developed a plan to investigate locations on the installation that may have contamination • shut down a contaminated drinking water well
Horsham Air Guard Station, Pennsylvania	May 2015, EPA	Levels of PFOS and PFOA above EPA's provisional health advisory levels were found in wells both on and off the installation from 2012 through 2015. The public water system on the installation serves approximately 440 Air Guard employees.	The Air National Guard • posted notices to not drink installation water and provided alternative drinking water • conducted sampling of private drinking water wells near the installation and provided alternative drinking water when necessary • funded water treatment system for off-base public wells with elevated levels of PFOS and PFOA
Former Naval Air Warfare Center Warminster, Pennsylvania[c]	July 2014, EPA	Levels of PFOS above EPA's provisional health advisory were found in drinking water wells in 2014. In addition, groundwater monitoring and extraction wells had elevated levels of PFOS and PFOA.	The Navy • funded a water treatment system on public wells contaminated with PFOS and PFOA • developed a plan to investigate for PFOS and PFOA at the installation • sampled private wells near the installation and provided alternative drinking water when necessary

Source: GAO analysis of information provided by the Ohio Environmental Protection Agency, EPA, and DOD. | GAO-18-78

[a]This information is based on the allegations, findings of fact, and conclusions of law contained in the relevant administrative orders.

[b]Pease Air Force Base was closed in 1991 under the Base Closure and Realignment Act process. The EPA administrative order directed DOD to address PFOS contamination at this former installation.

[c]Naval Air Warfare Center Warminster was closed in 1996 under the Base Closure and Realignment Act process. The EPA administrative order directed DOD to address PFOS contamination at this former installation.

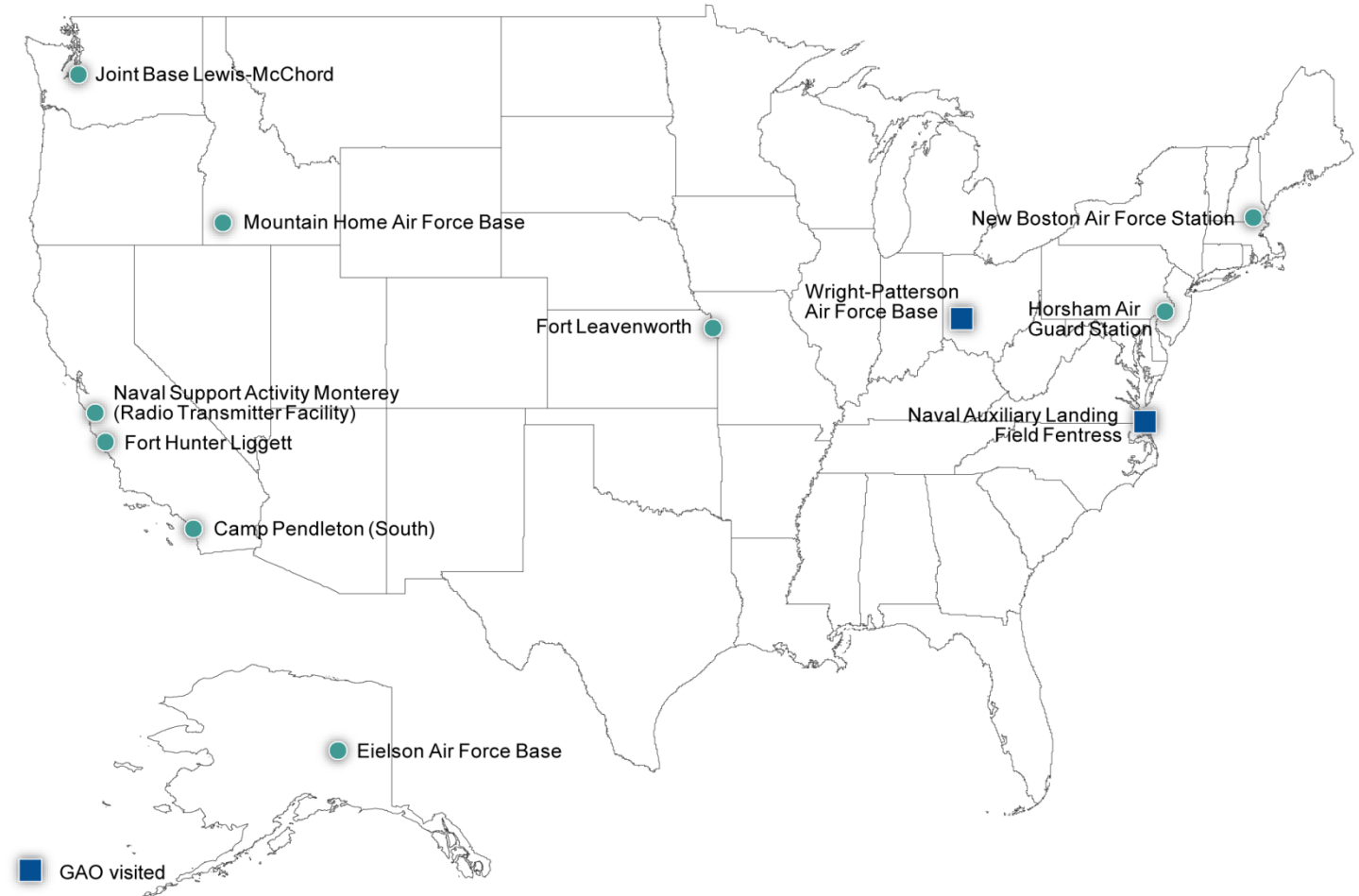
In addition to actions specific to these four installations, DOD has initiated other actions to test for, investigate, and mitigate elevated levels of PFOS and PFOA at or near installations across the military departments. Following the release of EPA's lifetime health advisory for PFOS and PFOA in May 2016, each of the military departments issued guidance directing installations to, among other things, test for PFOS and PFOA in their drinking water[48] and take steps to address drinking water that contained amounts of PFOS and PFOA above the EPA's lifetime health advisory level. The military departments also directed their installations to identify locations with a known or suspected prior release of PFOS and PFOA and to address any releases that pose a risk to human health—which can include people living outside DOD installations.

As a result of these efforts, DOD has initiated actions to address PFOS and PFOA in drinking water both on military installations and outside military installations. As of March 2017, DOD data indicated that the department was taking steps to address levels of PFOS and PFOA above the EPA's lifetime health advisory level in drinking water on 11 military installations in the United States, 2 of which we visited during the course of this review (see fig. 1).[49]

[48]According to DOD, the Army expects to complete its drinking water testing by the end of fiscal year 2017, while the Air Force and the Navy had completed their testing.

[49]DOD testing also found that four overseas installations had PFOS and PFOA in their drinking water above the EPA's lifetime health advisory levels. DOD efforts to test for and respond to PFOS and PFOA at overseas installations were outside the scope of our review.

Figure 1: Locations Where DOD Has Initiated Actions to Address Elevated Levels of PFOS and PFOA in Drinking Water on Military Installations, as of March 2017



PFOS = perfluorooctane sulfonate
PFOA = perfluorooctanoic acid
DOD = Department of Defense

Sources: GAO analysis of DOD data; Map Resources (map) | GAO-18-78

Note: Actions to address elevated levels of PFOS and PFOA in drinking water on these DOD installations include shutting down drinking water wells, providing alternative drinking water, and installing treatment systems.

According to DOD data, these installations took various corrective actions to mitigate the presence of PFOS and PFOA in the drinking water, including shutting down drinking water wells, providing alternative drinking water, and installing treatment systems. For example, at Eielson Air Force Base in Alaska, the Air Force reported shutting down three of the

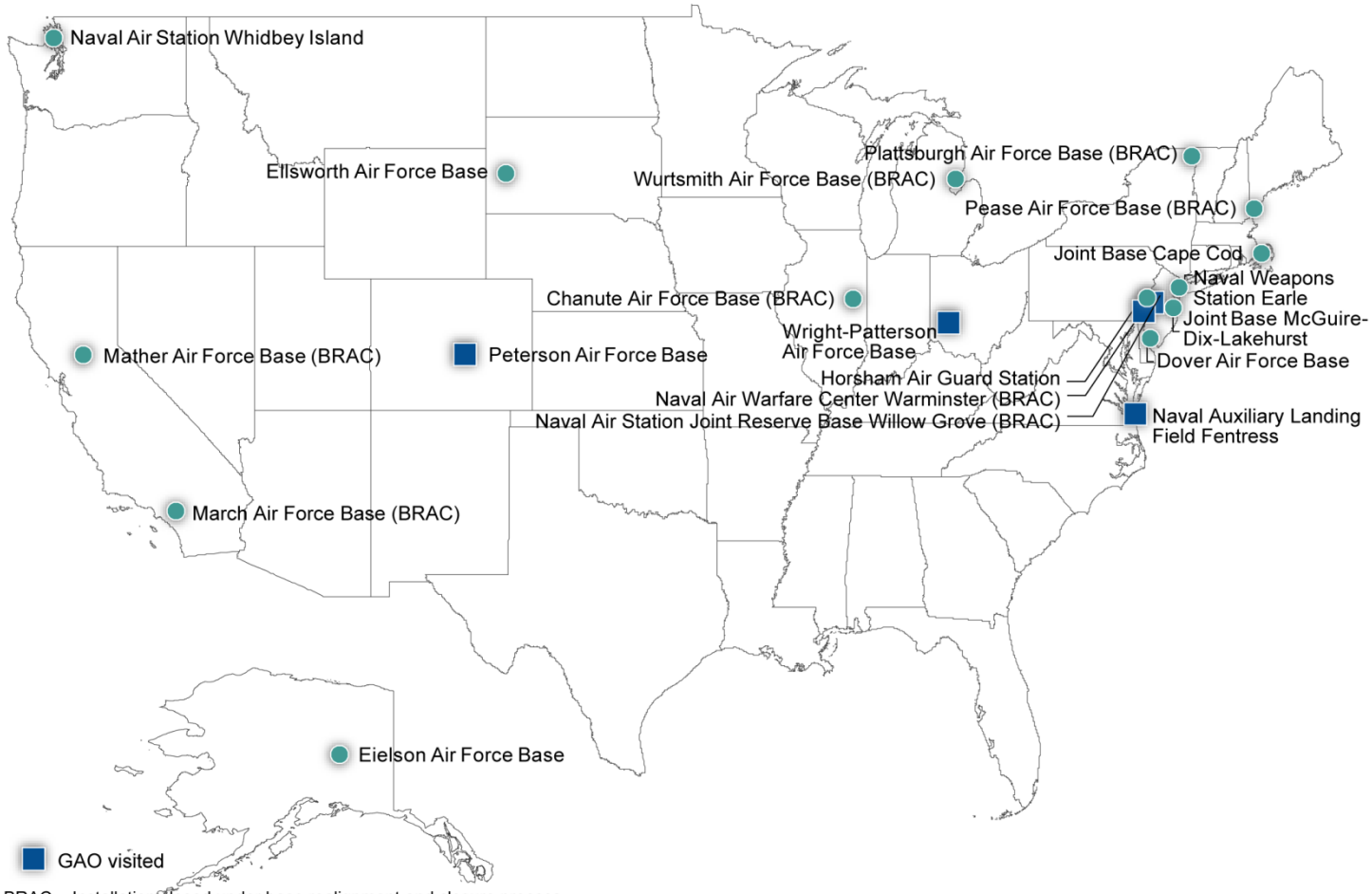
installation's six drinking water wells and installing a treatment system to remove PFOS and PFOA from the drinking water. At Marine Corps Base Camp Pendleton in California, the Navy reported that a well contaminated with PFOS and PFOA was taken out of service and that the affected reservoir was drained and replaced with water from another source; follow-on testing showed that the presence of PFOS and PFOA were returned to below the EPA's lifetime health advisory level. At Fort Leavenworth in Kansas, the Army reported that the private company that operates the installation's drinking water system had shut down two wells contaminated with PFOS and PFOA and plans to install a treatment system before returning those wells to service.

Additionally, according to DOD data as of December 2016 the military departments had identified 391 active and closed installations[50] with known or suspected releases of PFOS and PFOA, and had reported spending almost $200 million on environmental investigations and mitigation actions at or near 263 (or about 67 percent) of those installations.[51] In particular, DOD had initiated mitigation actions, which include installing treatment systems or supplying bottled water, to address PFOS and PFOA in drinking water for people living outside 19 installations—5 of which we visited during the course of this review (see fig. 2).

[50]According to the DOD data, 204 of the 263 installations where environmental investigations and mitigation actions have occurred are active installations, and 59 have been closed under the Base Realignment and Closure process. According to ASD (EI&E) officials, the Defense Logistics Agency identified 2 additional installations with a known or suspected release of PFOS and PFOA.

[51]Section 211 of the Superfund Amendments and Reauthorization Act of 1986 established DOD's Defense Environmental Restoration Program, providing legal authority and responsibility to DOD for cleanup activities at DOD installations and properties, including at former defense sites. DOD generally uses the Comprehensive Environmental Response, Compensation, and Liability cleanup process, which includes the following phases and activities, among others: preliminary assessment, site investigation, remedial investigation and feasibility study, remedial design and remedial action, and long-term monitoring. Section 120(h) of the Comprehensive Environmental Response, Compensation, and Liability Act, the act authorizing the Superfund program, contains provisions that establish requirements for the transfer or lease of federally owned property based on storage, disposal, or known release of hazardous substances. All contracts for transfer or lease must include notice of this storage, disposal, or release. Except as noted below, section 120(h)(3) requires that transfers of federal real property by deed must also include: (a) a covenant by the United States that all remedial action necessary to protect human health and the environment has been taken prior to transfer, (b) a covenant by the United States to undertake any further remedial action found to be necessary after transfer, and (c) a clause granting access to the transferred property in case remedial action or corrective action is found to be necessary after transfer.

Figure 2: Locations Where DOD Has Initiated Actions to Address PFOS and PFOA in Drinking Water Outside Military Installations, as of December 2016



BRAC = Installation closed under base realignment and closure process
DOD = Department of Defense
PFOS = perfluorooctane sulfonate
PFOA = perfluorooctanoic acid

Sources: GAO analysis of DOD data; Map Resources (map). | GAO-18-78

Note: Actions to address elevated levels of PFOS and PFOA in drinking water outside these DOD installations include installing treatment systems or supplying bottled water.

The following cost data provided by DOD were current as of December 2016, and are supplemented by additional information we obtained during our installation visits.

- The Air Force identified 203 installations with known or suspected releases of PFOS and PFOA, spent about $120 million on

environmental investigations at those installations, and spent about $33 million on mitigation actions at or near 14 of the 203 installations. For example, the Air Force reported spending over $5 million on environmental investigations and mitigation actions at Peterson Air Force Base in Colorado. During our visit to that installation, officials showed us the sites they are investigating—to include the current (see fig. 3 below) and former fire training areas—to determine the extent to which their prior use of firefighting foam may have contributed to the discovery of PFOS and PFOA in the drinking water of three nearby communities.[52] Additionally, the Air Force has awarded a contract for, among other things, installing treatment systems in those communities. In another example, the Air Force reported spending about $800,000 on environmental investigations at Joint Base Langley-Eustis in Virginia, but nothing yet on mitigation actions. During our visit to this installation, officials told us that they had not taken any mitigation actions because they do not use the installation's groundwater as a drinking water source; the utility that serves the installation, as well as the nearby city of Newport News, obtains its drinking water primarily from a surface water source, which officials said was approximately 20 miles from the installation.

[52]Peterson Air Force Base is colocated with the Colorado Springs Airport. According to installation officials, the installation has provided firefighting support to the airport for more than 25 years.

Figure 3: Current Fire Training Area at Peterson Air Force Base, Colorado

Source: GAO. | GAO-18-78

Note: The current fire training area at Peterson Air Force Base includes a mock aircraft positioned within a lined burn pit. According to the Air Force, firefighting foam was previously used at this fire training area, but current training activities use water to extinguish fire. The Air Force is also investigating former fire training areas at Peterson Air Force Base where firefighting foam was likely used.

- The Navy identified 127 installations with known or suspected releases of PFOS and PFOA, spent about $20.5 million on environmental investigations at 47 of those installations, and spent about $24 million on mitigation actions at or near 5 of those installations. For example, the Navy reported spending about $15 million on environmental investigations and mitigation actions at the former Naval Air Station Joint Reserve Base Willow Grove in Pennsylvania.[53] During our visit to this installation, officials told us that the Navy is investigating the extent to which PFOS and PFOA on the installation may have contaminated a nearby town's drinking water. The Navy has agreed to fund installation of treatment systems and connections of private well owners to the town's drinking water system, among other things. In another example, the Navy reported spending nearly $3 million on environmental investigations and

[53]Naval Air Station Joint Reserve Base Willow Grove was closed under the 2005 Base Realignment and Closure round.

mitigation actions at Naval Auxiliary Landing Field Fentress in Virginia. During our visit to this installation, officials told us that the Navy is providing bottled water to the approximately 20 to 30 personnel who work there and plans to install a treatment system to treat for PFOS and PFOA.

- The Army identified 61 installations with known or suspected releases of PFOS and PFOA, spent about $1.6 million on environmental investigations at 13 of those installations, and has not yet begun any mitigation actions at or near the identified installations. For example, the Army reported spending about $26,000 on environmental investigations at Fort Carson in Colorado, but nothing yet on mitigation actions. During our visit to this installation, officials told us that they had found PFOS and PFOA in groundwater near their previous fire training area but that the installation does not use that groundwater as a drinking water source, and state officials told us that it is unlikely that PFOS and PFOA from Fort Carson had affected any nearby drinking water sources.

According to DOD, it may take several years for the department to determine how much it will cost to cleanup PFOS and PFOA contamination at or near its military installations. In January 2017, we reported that DOD had not notified Congress that the costs for environmental cleanup at closed installations will significantly increase due to the high cost of remediating emerging contaminants—including PFOS and PFOA.[54] We also reported that DOD officials had not determined the total costs for cleaning up emerging contaminants at closed installations. We recommended that DOD include in future annual reports to Congress best estimates of the environmental cleanup costs for emerging contaminants as additional information becomes available, and DOD concurred with the recommendation and stated its commitment to do so.

DOD Previously Directed Installations to Test for Perchlorate in Drinking Water

DOD previously directed installations to test for perchlorate in drinking water. Following the EPA's issuance of an interim drinking water health advisory for perchlorate in 2008, DOD issued policy in April 2009—which superseded similar policy that was issued in January 2006—directing DOD-owned drinking water systems that were testing for inorganic

[54]GAO, *Military Base Realignments and Closures: DOD Has Improved Environmental Cleanup Reporting but Should Obtain and Share More Information*, GAO-17-151 (Washington, D.C.: Jan. 19, 2017).

substances to also test for perchlorate. Installations that found perchlorate in their drinking water were to consult with their leadership on appropriate actions to take and to continue testing on a quarterly basis until they determined that perchlorate levels were likely to remain below EPA's health advisory level, or any applicable federal or state regulation. Citing congressional and regulatory agency concerns related to perchlorate, DOD developed a database for storing the results of perchlorate testing. According to ASD (EI&E), the database was last updated in 2009 and is no longer being used by the department.

ASD (EI&E) officials stated that they are no longer regularly testing drinking water for perchlorate unless there is a state requirement to do so; previous testing indicated that DOD was not a primary source of perchlorate in drinking water and that known releases of perchlorate did not currently pose a threat to drinking water. According to EPA, the agency expects to issue a final drinking water regulation for perchlorate by the end of 2019. ASD (EI&E) officials told us that, once EPA has issued a final regulation, DOD is committed to complying with it.[55]

Conclusions

During the period we reviewed, DOD data indicate that DOD public water systems complied with EPA and state health-based drinking water regulations at a level comparable with other systems in the United States. However, we found that the military departments did not report all violations of these regulations to ASD (EI&E) during that period, which illustrates that DOD's internal reporting requirements for drinking water data are either not clear in DOD regulations or are not clearly understood by those implementing them. Unless ASD (EI&E) and the military departments act to make any necessary clarifications to and increase understanding of DOD's annual reporting requirements, ASD (EI&E) may not have complete data to effectively oversee the military departments' compliance with drinking water regulations. Further, the data indicated that systems providing DOD-treated drinking water had more reported

[55]We have previously reported on DOD actions to address perchlorate. In GAO, *Perchlorate: Occurrence Is Widespread but at Varying Levels; Federal Agencies Have Taken Some Actions to Respond to and Lessen Releases*, GAO-10-769 (Washington, D.C.; Aug. 12, 2010), we reported that DOD had sampled for perchlorate at DOD installations that had a potential or suspected release from fiscal years 1997 through 2009. In those cases where perchlorate concentrations were found in drinking water sources—such as groundwater or surface water—above DOD's screening threshold, DOD was to initiate further testing of the site. We also reported in that 2010 report that DOD had provided funding for research and development of perchlorate treatment technologies.

health-based violations than DOD systems providing non-DOD-treated drinking water. However, DOD has not used these data to identify the reasons that these differences may exist. Without using available data to identify why differences in violations appear to exist between DOD's two types of public water systems, DOD will likely be hampered in its ability to identify what actions, if any, could be taken to address any differences and improve overall compliance with health-based drinking water regulations.

Recommendations for Executive Action

We are making a total of five recommendations to DOD.

The Assistant Secretary of Defense for Energy, Installations, and Environment, in consultation with the Secretaries of the military departments, should identify and implement any necessary changes to DOD's environmental compliance policy to clarify DOD's reporting requirements for violations of health-based drinking water regulations. (Recommendation 1)

The Secretary of the Army should identify and implement actions to increase understanding at Army installations and commands about DOD's reporting requirements for violations of health-based drinking water regulations. These actions may include improved communication to or additional training for personnel. (Recommendation 2)

The Secretary of the Navy should identify and implement actions to increase understanding at Navy installations and commands about DOD's reporting requirements for violations of health-based drinking water regulations. These actions may include improved communication to or additional training for personnel. (Recommendation 3)

The Secretary of the Air Force should identify and implement actions to increase understanding at Air Force installations and commands about DOD's reporting requirements for violations of health-based drinking water regulations. These actions may include improved communication to or additional training for personnel. (Recommendation 4)

The Assistant Secretary of Defense for Energy, Installations, and Environment, in consultation with the Secretaries of the military departments, should (a) review reported compliance data to identify the reasons for any differences in the number of violations of health-based drinking water regulations between DOD's two types of public water systems and (b) identify and implement any actions needed to address

the causes of any differences in the number of violations between DOD's two types of public water systems. (Recommendation 5)

Agency Comments and Our Evaluation

We provided a draft of this report to DOD and EPA for review and comment. In its written comments, reproduced in appendix III, DOD concurred with our recommendations. DOD and EPA also provided technical comments, which we incorporated as appropriate. Based on technical comments from DOD, we revised the title of the report to more clearly specify the actions DOD should take to address the findings in our report.

We are sending copies of this report to the appropriate congressional committees; the Secretary of Defense; the Assistant Secretary of Defense for Energy, Installations, and Environment; the Secretaries of the Army, the Navy, and the Air Force; and the Administrator of EPA. In addition, the report is available at no charge on the GAO website at http://www.gao.gov.

If you or your staff have any questions about this report, please contact us at J. Alfredo Gómez, (202) 512-3841 or gomezj@gao.gov, or Brian J. Lepore, (202) 512-4523 or leporeb@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions to this report are listed in appendix IV.

J. Alfredo Gómez
Director, Natural Resources and Environment

Brian J. Lepore
Director, Defense Capabilities and Management

List of Committees

The Honorable John McCain
Chairman
The Honorable Jack Reed
Ranking Member
Committee on Armed Services
United States Senate

The Honorable Thad Cochran
Chairman
The Honorable Richard Durbin
Ranking Member
Subcommittee on Defense
Committee on Appropriations
United States Senate

The Honorable Jerry Moran
Chairman
The Honorable Brian Schatz
Ranking Member
Subcommittee on Military Construction, Veterans Affairs and Related Agencies
Committee on Appropriations
United States Senate

The Honorable Mac Thornberry
Chairman
The Honorable Adam Smith
Ranking Member
Committee on Armed Services
House of Representatives

The Honorable Kay Granger
Chairwoman
The Honorable Pete Visclosky
Ranking Member
Subcommittee on Defense
Committee on Appropriations
House of Representatives

The Honorable Charles Dent
Chairman
The Honorable Debbie Wasserman Schultz
Ranking Member
Subcommittee on Military Construction, Veterans Affairs
and Related Agencies
Committee on Appropriations
House of Representatives

Appendix I: Objectives, Scope, and Methodology

Senate Report 114-255 accompanying a bill for the national defense authorization for fiscal year 2017 included a provision for us to review the Department of Defense's (DOD) efforts to manage contaminants in drinking water. This report examines the extent to which DOD has (1) internally reported data on compliance with health-based drinking water regulations at military installations and used those data to assess compliance at its two types of public water systems and (2) taken actions to address concerns with its firefighting foam containing perfluorinated chemicals (PFCs) and to address elevated levels of perfluorooctanesulfonic acid (PFOS), perfluorooctanoic acid (PFOA), and perchlorate in drinking water at or near military installations.

For objective one, we reviewed DOD's policy on environmental compliance in the United States, which directs the military departments to annually report data to the Assistant Secretary of Defense for Energy, Installations, and Environment (ASD (EI&E)) on compliance with and violations of Environmental Protection Agency (EPA) and state health-based drinking water regulations at military installations.[1] We analyzed data reported by the military departments to ASD (EI&E) on compliance with and violations of health-based drinking water regulations at DOD public water systems located at military installations in the United States for fiscal years 2013 through 2015, the most recent data available at the time of our review. We analyzed the data to identify (1) the number of people served by DOD public water systems that complied with applicable EPA and state health-based drinking water regulations during the fiscal year and (2) the number of people served by DOD public water systems that violated at least one of these regulations sometime during the fiscal year. We performed this analysis for both types of DOD public water systems—those that provide DOD-treated drinking water, and those that provide non-DOD-treated drinking water. We also used the data to identify the military installations where the reported violations occurred; the nature of the violation (including the contaminant involved); and the number of people affected. Next, we collected data from EPA's Safe Drinking Water Information System for all public water systems in

[1]DOD Instruction 4715.06, *Environmental Compliance in the United States* (May 4, 2015).

the United States.[2] We used DOD-provided public water system identification numbers to identify in the EPA system any violations for health-based drinking water regulations at those DOD systems for fiscal years 2013 through 2015. We then compared the violations found in EPA's data to the data reported by the military departments to ASD (EI&E) to determine the extent to which the military departments were reporting all violations of health-based drinking water regulations to ASD (EI&E).

We also analyzed DOD's data to identify any differences in violations between DOD- and non-DOD-treated drinking water. We evaluated the military departments' reported data and DOD's use of these data to determine compliance with DOD's reporting requirements in the department's environmental compliance instruction[3] and *Standards for Internal Control in the Federal Government*. According to these standards, quality information is needed to achieve an organization's objectives, management is to monitor performance over time and promptly resolve any findings, and actions such as improved communication to and additional training for personnel are helpful for an organization to meet its objectives.[4] We also discussed our analysis with ASD (EI&E) and military department officials, and discussed possible reasons for why any violations went unreported to ASD (EI&E) and why there may be differences in violations between DOD- and non-DOD-treated drinking water. We assessed the reliability of the DOD and EPA data on violations of health-based drinking water regulations by reviewing relevant documentation, testing the data for obvious errors, and interviewing knowledgeable officials. As we have previously found, EPA's data system may not contain all public water violations as states have

[2]States collect and manage relevant data (including violations and enforcement information) in either a database provided by EPA—known as the Safe Drinking Water Information System/State—or in a data system of their own design. The states also periodically transfer from their database information on violations and enforcement actions to the EPA headquarters version of the Safe Drinking Water Information System (known as Safe Drinking Water Information System/Federal). EPA generally uses the data in its version of the system—along with other documentation provided on request—to review state determinations of when water systems are complying with the act. EPA also uses these data to determine whether water systems, in the aggregate, are achieving the agency's national targets for compliance.

[3]DOD Instruction 4715.06.

[4]GAO, *Standards for Internal Control in the Federal Government*, GAO-14-704G (Washington, D.C.: September 2014).

under-reported the violations.[5] During this review, we found that some public water system identification numbers for DOD installations could not be matched with EPA's system and, therefore, were excluded from our analysis.[6] As a result, some DOD installation violations may be missing from the data, and we may not have comprehensive violations data for health-based drinking water regulations at DOD installations. Nonetheless, we determined that DOD and EPA data were sufficiently reliable for the purpose of identifying whether any drinking water violations were recorded in EPA's system but not internally reported within DOD, and to indicate possible differences in drinking water violations, as reported by the military departments, between DOD's two types of public water systems.

For objective two, we reviewed policies issued by the military departments on the use of firefighting foam that contains PFCs.[7] We also reviewed DOD documents related to research into PFC-free firefighting foams that can meet the department's performance and compatibility requirements, as well as DOD's military specification document that outlines those requirements.[8] We met with officials from ASD (EI&E) and the military departments to discuss their policies on the use of firefighting foam and actions taken to address concerns with the use of firefighting foam containing PFCs, including the future use of firefighting foam. Additionally, we met with Navy officials responsible for testing existing firefighting foam products and setting the military specifications for firefighting foam use in DOD.

Additionally, we obtained and reviewed four regulatory administrative orders—three from EPA and one from the Ohio Environmental Protection

[5]GAO, *Drinking Water: Unreliable State Data Limit EPA's Ability to Target Enforcement Priorities and Communicate Water Systems' Performance*, GAO-11-381 (Washington, D.C.: June 2011).

[6]We were able to match 440 public water systems that serve DOD installations to EPA's data and not able to match 296 systems.

[7]Assistant Chief of Staff of the Army for Installation Management Memorandum, *Limiting Use of Aqueous Film Forming Foam* (June 29, 2016); Office of the Assistant Secretary of the Navy for Energy, Installations, and Environment Memorandum, *Aqueous Film Forming Foam (AFFF) Control, Removal, and Disposal* (June 17, 2016); and Office of the Assistant Secretary of the Air Force for Installations, Environment, and Energy Memorandum, *SAF/IE Policy on Perfluorinated Compounds (PFCs) of Concern* (Aug. 11, 2016).

[8]DOD, MIL-F-24385, *Military Specification, Fire Extinguishing Agent, Aqueous Film-Forming Foam (AFFF) Liquid Concentrate, for Fresh and Sea Water* (SH) (Aug. 5, 1994).

Agency—directing DOD to address elevated levels of PFOS and PFOA contamination in drinking water at or near four active and closed military installations, and reviewed documentation related to DOD's efforts to address these administrative orders. We also met with officials from Ohio and the EPA regions that issued the orders—EPA Regions 1 and 3—as well as DOD officials who responded to the orders, to discuss DOD's response to the orders.[9] We reviewed drinking water guidance issued by ASD (EI&E) and the military departments on testing installation drinking water for PFOS and PFOA[10] and responding to known or suspected releases of PFOS and PFOA.[11] We analyzed DOD-provided data on the installations where DOD-conducted testing showed the presence of PFOS and PFOA in drinking water above the EPA's health advisory level for those contaminants (as of March 2017) and on the costs and actions taken to investigate and mitigate PFOS and PFOA at or near military installations (as of December 2016). We assessed the reliability of the data by examining the data for obvious errors and inconsistencies, comparing the data, where applicable, with other information collected, and by interviewing knowledgeable officials; we found the data to be sufficiently reliable for our purposes of describing what DOD has reported on its actions and costs for responding to PFOS and PFOA.

[9]EPA has 10 regions in the United States, each responsible for carrying out EPA programs within several states and territories.

[10]Office of the Assistant Secretary of Defense for Energy, Installations, and Environment Memorandum, *Testing DOD Drinking Water for Perfluorooctane Sulfonate (PFOS) and Perfluorooctanoic Acid (PFOA)* (June 10, 2016); Office of the Assistant Secretary of the Army for Installations, Energy, and Environment Memorandum, *Perfluorinated Compound (PFC) Contamination Assessment* (June 10, 2016); Office of the Assistant Secretary of the Navy for Energy, Installations, and Environment Memorandum, *Perfluorinated Compounds (PFCs) Drinking Water System Testing Requirement* (June 14, 2016); and Office of the Assistant Secretary of the Air Force for Installations, Environment, and Energy Memorandum, *Testing Drinking Water for Perfluorooctane Sulfonate (PFOS) and Perfluorooctanoic Acid (PFOA)* (Aug. 12, 2016).

[11]Office of the Assistant Secretary of the Army for Installations, Energy, and Environment Memorandum, *Perfluorinated Compound (PFC) Contamination Assessment* (June 10, 2016); Office of the Assistant Secretary of the Navy for Energy, Installations, and Environment Memorandum*, Perfluorinated Compounds/Perfluoroalkyl Substances (PFC/PFAS) - Identification of Potential Areas of Concern (AOCs)* (June 20, 2016); and Office of the Assistant Secretary of the Air Force for Installations, Environment, and Energy Memorandum, *SAF/IE Policy on Perfluorinated Compounds (PFCs) of Concern* (Aug. 11, 2016).

Additionally, we reviewed DOD policy and our prior work on testing for and responding to perchlorate at military installations.[12] We met with ASD (EI&E) and military department officials to discuss DOD actions to address PFOS, PFOA, and perchlorate. To obtain additional information on DOD actions to address emerging contaminants in drinking water, we conducted site visits to a nongeneralizable sample of seven current and former military installations—at least two installations per military department—that were selected because they were investigating or responding to unregulated DOD-identified emerging contaminants in drinking water; these installations are listed below.[13] We also met with EPA and state regulatory officials to better understand how DOD was responding to administrative orders and addressing PFOS, PFOA, and perchlorate at or near DOD installations. Specifically, we met with officials from selected EPA regions and state regulatory offices that had issued an administrative order for PFOS and PFOA or whose region or state included the installations we visited; those EPA regions and states are listed below. We also compared DOD's list of emerging contaminants with EPA documentation to determine how many DOD-identified emerging contaminants (1) have been regulated by EPA under the Safe Drinking Water Act or (2) are currently unregulated but have an EPA-issued drinking water health advisory.

We visited or contacted the following offices and locations during our review. Unless otherwise specified, these organizations are located in or near Washington, D.C.

Office of the Secretary of Defense

- Office of the Assistant Secretary of Defense for Energy, Installations, and Environment
- Office of the Deputy Assistant Secretary of Defense for Environment, Safety, and Occupational Health

[12]GAO, *Perchlorate: Occurrence Is Widespread but at Varying Levels; Federal Agencies Have Taken Some Actions to Respond to and Lessen Releases*, GAO-10-769 (Washington, D.C.; Aug. 12, 2010) and *Environmental Contamination: Department of Defense Activities Related to Trichloroethylene, Perchlorate, and Other Emerging Contaminants*, GAO-07-1042T (Washington, D.C.; July 12, 2007).

[13]We conducted in-person visits to all of the installations listed below except for the former Pease Air Force Base, New Hampshire.

Department of the Army

- Office of the Assistant Chief of Staff of the Army for Installation Management
- U.S. Army Installations Management Command, Fort Sam Houston, Texas
- U.S. Army Environmental Command, Fort Sam Houston, Texas
- Fort Carson, Colorado
- Fort Jackson, South Carolina

Department of the Navy

- Office of the Assistant Secretary of the Navy for Energy, Installations, and Environment
- Office of the Chief of Naval Operations, Energy and Environmental Readiness Division
- Commander, Navy Installations Command
- Marine Corps Installations Command
- Naval Facilities Engineering Command
- Naval Sea Systems Command
- Former Naval Air Station Joint Reserve Base Willow Grove, Pennsylvania
- Naval Auxiliary Landing Field Fentress, Virginia

Department of the Air Force

- Office of the Assistant Secretary of the Air Force for Installations, Environment, and Energy
- Air Force Civil Engineer Center, Joint Base San Antonio, Texas
- Former Pease Air Force Base, New Hampshire
- Joint Base Langley-Eustis, Virginia
- Peterson Air Force Base, Colorado
- Wright-Patterson Air Force Base, Ohio

EPA

- Office of Water
- Office of Research and Development
- Office of Land and Emergency Management
- Office of Enforcement and Compliance Assurance
- EPA Region 1, Boston, Massachusetts
- EPA Region 3, Philadelphia, Pennsylvania
- EPA Region 4, Atlanta, Georgia
- EPA Region 5, Chicago, Illinois
- EPA Region 8, Denver, Colorado
- EPA Region 9, San Francisco, California

State Environmental Regulatory Agencies

- Colorado Department of Public Health and Environment
- Ohio Environmental Protection Agency
- Pennsylvania Department of Environmental Protection
- South Carolina Department of Health and Environmental Control

We conducted this performance audit from June 2016 to October 2017 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Appendix II: Drinking Water Regulatory Status for Department of Defense-Identified Emerging Contaminants

The Department of Defense's (DOD) list of emerging contaminants includes 21 contaminants that can be found in drinking water: 10 that have been regulated by the Environmental Protection Agency (EPA) under the Safe Drinking Water Act and 11 that are currently unregulated but have an EPA-issued drinking water health advisory. Table 4 shows the regulatory status for each of the 21 contaminants.

Table 4: Drinking Water Regulatory Status for Department of Defense (DOD)-Identified Emerging Contaminants

DOD-identified emerging contaminant	Contaminant's CAS registry number[a]	Contaminant is regulated under the Safe Drinking Water Act	Contaminant is addressed in an Environmental Protection Agency (EPA) drinking water health advisory (no National Primary Drinking Water Regulation)
Antimony	7440-36-0	X	–
Beryllium	7440-41-7	X	–
Cadmium and compounds	7440-43-9	X	–
Chromium VI[b]	18540-29-9	X	–
Dioxins[c]	n/a[d]	X	–
Ethylbenzene	100-41-4	X	–
Lead compounds	7439-92-1	X	–
Methylene chloride	75-09-2	X	–
Phthalate esters[e]	n/a[d]	X	–
Trichloroethylene (TCE)	79-01-6	X	–
1,4-dioxane	123-91-1	–	X
Cyclotrimethylenetrinitramine (RDX)	121-82-4	–	X
Dinitrotoluene (DNT)[f]	25321-14-6	–	X
Manganese and compounds	7439-96-5	–	X
Naphthalene	91-20-3	–	X
Nickel	7440-02-0	–	X
N-Nitrosodimethylamine (NDMA)[g]	62-75-9	–	X
Perchlorate[h]	14797-73-0	–	X
Perfluorooctane sulfonic acid (PFOS)	1763-23-1	–	X
Perfluorooctanoic Acid (PFOA)	335-67-1	–	X
Strontium[i]	7440-24-6	–	X

Legend: X= has a regulation or health advisory; – = does not have a regulation or health advisory.

Source: GAO analysis of DOD and EPA data. | GAO-18-78

[a]CAS registry numbers are generally accepted unique numeric identifiers for chemical substances.
[b]EPA has regulated total chromium, which includes chromium VI.
[c]EPA has regulated 2,3,7,8-tetrachlorodibenzo-p-dioxin, which EPA states is the most studied and most toxic of all dioxins.

[d]No CAS registry numbers were provided by DOD because the contaminant name is referring to a group of related chemicals.
[e]EPA has regulated di(2-ethylhexyl) phthalate, which DOD has identified as a phthalate ester of concern.
[f]EPA has issued health advisories for 2,4- and 2,6-DNT, which DOD has identified as DNTs of concern.
[g]EPA has not issued a health advisory document for NDMA but has issued a lifetime health advisory level corresponding to an increased cancer risk.
[h]EPA issued an interim health advisory for perchlorate in 2008.
[i]EPA issued a draft health advisory for strontium in 1993. EPA has established a maximum containment level for beta particle and photon radioactivity from man-made radionuclides in drinking water, including strontium-90, requiring that such radioactivity must not produce an annual dose equivalent to the total body or any internal organ greater than 4 millirem/year (mrem/year). 40 C.F.R. § 141.66(d).

Appendix III: Comments from the Department of Defense

ASSISTANT SECRETARY OF DEFENSE
3400 DEFENSE PENTAGON
WASHINGTON, DC 20301-3400

ENERGY,
INSTALLATIONS,
AND ENVIRONMENT

SEP 2 9 2017

Mr. Brian Lepore
Director, Defense Capabilities Management
U.S. Government Accountability Office
441 G Street, NW
Washington, DC 20548

Dear Mr. Lepore:

This is the Department of Defense (DoD) response to the GAO Draft Report, GAO-18-78, "DRINKING WATER: DoD Has Acted on Some Emerging Contaminants but Could Better Oversee Regulatory Compliance," August 22, 2017 (GAO Code 100947). The DoD response to the GAO recommendations is enclosed. Detailed comments on the report were provided by separate email.

The DoD concurs with all five recommendations. DoD and the Military Departments will review and revise internal drinking water compliance guidance to clarify reporting health-based violations. DoD will also evaluate the compliance differences between the types of DoD drinking water systems. My office will work with the Military Services through the DoD Safe Drinking Water Act Service Steering Committee to make recommendations on changes to our compliance reporting guidance.

The Department appreciates the opportunity to comment on the draft report.

Sincerely,

Lucian Niemeyer

Enclosure:
As stated

GAO DRAFT REPORT DATED AUGUST 22, 2017
GAO-18-78 (GAO CODE 100947)

"DRINKING WATER: DOD HAS ACTED ON SOME EMERGING CONTAMINANTS BUT COULD BETTER OVERSEE REGULATORY COMPLIANCE"

DEPARTMENT OF DEFENSE COMMENTS TO THE GAO RECOMMENDATION

RECOMMENDATION 1: The GAO recommends that the Assistant Secretary of Defense for Energy, Installations, and Environment, in consultation with the Secretaries of the military departments, should identify and implement any necessary changes to DOD's environmental compliance policy to clarify DOD's reporting requirements for violations of health-based drinking water regulations.

DoD RESPONSE: *Concur. The Assistant Secretary of Defense for Energy, Installations, and Environment will work with the Military Departments through the DoD Safe Drinking Water Act Services Steering Committee to review and clarify DoD internal reporting requirements for violations of health based drinking water regulations and make appropriate policy changes.*

RECOMMENDATION 2: The GAO recommends that the Secretary of the Army should identify and implement actions to increase understanding at their installations and commands about DOD's reporting requirements for violations of health-based drinking water regulations. These actions may include improved communication to or additional training for personnel.

DoD RESPONSE: *Concur. The Army will work with Army staff and the DoD Safe Drinking Water Act Services Steering Committee to clarify DoD's internal reporting requirements for violations of health based drinking water regulations and implement appropriate changes.*

RECOMMENDATION 3: The GAO recommends that the Secretary of the Navy should identify and implement actions to increase understanding at their installations and commands about DOD's reporting requirements for violations of health-based drinking water regulations. These actions may include improved communication to or additional training for personnel.

DoD RESPONSE: Concur. *The Navy will work with the Navy staff and the DoD Safe Drinking Water Act Services Steering Committee to clarify DoD's internal reporting requirements for violations of health based drinking water regulations and implement appropriate changes.*

RECOMMENDATION 4: The GAO recommends that the Secretary of the Air Force should identify and implement actions to increase understanding at their installations and commands about DOD's reporting requirements for violations of health-based drinking water regulations. These actions may include improved communication to or additional training for personnel.

DoD RESPONSE: Concur. *The Air Force will work with Air Force staff and the DoD Safe Drinking Water Act Services Steering Committee to clarify DoD's internal reporting*

requirements for violations of health based drinking water regulations and implement appropriate changes.

RECOMMENDATION 5: The GAO recommends that the Assistant Secretary of Defense for Energy, Installations, and Environment, in consultation with the Secretaries of the military departments, should (a) review reported compliance data to identify the reasons for any differences in the number of violations of health-based drinking water regulations between DOD's two types of water systems; and (b) identify and implement any actions needed to address the causes of any differences in the number of violations between DOD's two types of public water systems.

DoD RESPONSE: *Concur. The Assistant Secretary of Defense for Energy, Installations, and Environment will work with the Military Departments through the DoD Safe Drinking Water Act Services Steering Committee to review internal compliance data on DoD's drinking water systems to identify appropriate actions needed to address inconsistencies.*

Appendix IV: GAO Contacts and Staff Acknowledgments

GAO Contacts

J. Alfredo Gómez, (202) 512-3841 or gomezj@gao.gov

Brian J. Lepore, (202) 512-4523 or leporeb@gao.gov

Staff Acknowledgments

In addition to the contacts named above, Maria Storts (Assistant Director), Diane B. Raynes (Assistant Director), Kazue Chinen, Michele Fejfar, Jennifer Gould, Karen Howard, Richard P. Johnson, Mae Jones, Daniel Kuhn, Summer Lingard-Smith, Daniel Longo, Felicia Lopez, Geoffrey Peck, Ophelia Robinson, Jerry Sandau, and Sara Sullivan made key contributions to this report.

Air Force PFOS/PFOA Snapshot

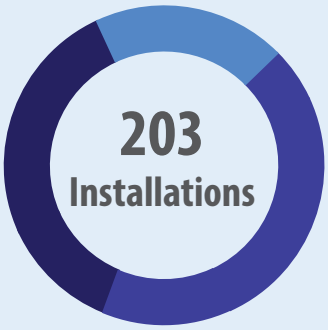
Perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) are synthetic fluorinated organic chemicals that were used in many industrial and consumer products such as nonstick cookware, stain-resistant fabric and carpet, some food packaging and specialized foam.

Commonly grouped with other synthetic fluorinated chemicals using the umbrella term Perfluorinated Compounds — or PFCs — PFOS and PFOA are the only two compounds of this group with established Environmental Protection Agency health advisories for drinking water.

Significant Information

- In 1970, the Air Force began using the firefighting agent Aqueous Film Forming Foam, or AFFF, which contained both PFOS and PFOA.
- AFFF is the most efficient extinguishing method for petroleum-based fires and is widely used across the firefighting industry, to include all commercial airports, to protect people and property.
- On May 19, 2016, the Environmental Protection Agency established a lifetime health advisory (LHA) level of 70 parts per trillion for PFOS and/or PFOA in drinking water. The health advisory is non-regulatory and not enforceable; however, under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) it is used in the absence of standards to determine an acceptable level of PFOS/PFOA in drinking water.

IDENTIFY



39 BRAC
90 Active Duty/Reserve
74 Air National Guard

95%
Preliminary Assessment Reports Complete

190 Installations
Expected to Require Further Site Inspection

RESPOND

18
Installations

Ongoing Air Force Drinking Water Mitigation:

- Bottled water
- Whole-house filtration
- Municipal water supply hookup
- Alternate water supplies

$154.7M PFOS/PFOA Actions to date investigations | mitigations

BRAC
K.I. Sawyer
March
Pease
Plattsburgh
Wurtsmith

ACTIVE/RESERVE
Dover
Eielson
Ellsworth
Fairchild
JB Cape Cod
JB McGuire-Dix-Lakehurst
Mountain Home
New Boston
Peterson
Wright-Patterson

ANG
Horsham
Toledo
Gabreski

PREVENT

173/176
Installations transitioned to new C6 AFFF

$4.7M
Cost for ecologic system kits for fire vehicles

15.7%
Installations finished retrofitting vehicles with ecologic system kits

979,000
Gallons of legacy AFFF incinerated

$10.8M
Cost to date to replace and incinerate legacy AFFF in stockpiles and fire trucks

Current as of 12 October 2017

1-866-725-7617 • (210) 925-0956 • afcec.pa@us.af.mil • www.afcec.af.mil

Installations Status Update

On-base Drinking Water Mitigation

1. Mountain Home AFB, ID
Two on-base drinking water wells tested above the LHA; wells taken offline and bottled water provided

2. New Boston AFS, NH
One on-base drinking water well above LHA; well taken offline.

3. Wright-Patterson AFB, OH
Two on-base drinking water wells tested above the LHA; wells taken offline and filtration systems installed

Off-base Drinking Water Mitigation

4. Dover AFB, DE
One off-base residential well result above LHA; filtration system provided

5. Ellsworth AFB, SD
One off-base residential well result above LHA; connected to base water supply

6. Fairchild AFB, WA
Two municipal wells tested above LHA; wells taken offline. 58 off-base residential wells tested above LHA; bottled water provided

7. Former K.I. Sawyer AFB, MI
One residential well tested above LHA; bottled water provided

8. Former March ARB, CA
Two off-base residential wells tested above the LHA; providing alternate drinking water source; one municipal well shut off

9. Former Pease AFB, NH
One public well shut off; filtration systems installed at 4 residences; 1 residence provided bottled water

10. Former Plattsburgh AFB, NY
Three off-base residences provided filtration systems; 1 off-base residence provided bottled water

11. Former Wurtsmith AFB, MI
One off-base residence connected to municipal water supply

12. Gabreski ANGB, NY
County wells tested above LHA; AF negotiating a cooperative agreement with Suffolk County; One residential well tested above LHA; ANG took over providing bottled water from the city to the residence

13. JB Cape Cod, MA
17 residential wells and one public water supply well tested above LHA; 74 off-base residences provided bottled water, 13 filtration systems installed

14. Peterson AFB, CO
Addressing concerns of local drinking water purveyors. 31 municipal wells tested above LHA; wells taken offline, 5 back on line with treatment systems. 83 private wells tested, 39 tested above LHA; 67 off-base locations provided bottled water; 26 residences provided filtration systems

15. Toledo ANG, OH
One off-base residential well above LHA; ANG provided bottled water and working with county on a cooperative agreement to hook the residence up to municipal water

Both On-base and Off-base Drinking Water Mitigation

16. Eielson AFB, AK
On-base drinking water well taken offline. 169 off-base wells tested above LHA; 163 filtration systems installed, remaining residences provided bottled water

17. Horsham ANG, PA
Under Administrative Order. Two on-base drinking water wells tested above the LHA; temporary carbon filtration installed and bottled water provided. 59 off-base private wells and five municipal wells tested above the LHA. Currently providing alternate water sources to surrounding townships while carbon filtration systems are constructed

18. JB McGuire-Dix-Lakehurst, NJ
Two on-base backup wells tested above the LHA; wells taken offline. Three off-base wells above LHA; 3 filtration systems installed. Evaluating connection to municipal water lines as permanent solution

Other Mitigation Actions

19. Barnes ANGB, MA
Two municipal wells tested above LHA; wells taken offline. One private well tested above LHA. State providing alternate water source to 3 off-base residences

20. Burlington ANG, VT
Non-drinking water (agricultural) water leachate at off-site private well tested above the LHA; State installed carbon filtration treatment

21. Former Chanute AFB, IL
Non-drinking water: leachate being treated for discharge to wastewater treatment plant

22. Joe Foss Field, SD
10 public wells above LHA; Alternate water supply provided by other public wells

23. Martinsburg ANG, WV
One municipal well above LHA taken offline; AF negotiating a cooperative agreement; pending legal review

24. Former Mather AFB, CA
Non-drinking water: effluent from pump and treat system being treated prior to re-injection near private wells

25. New Castle ANG, DE
11 municipal wells tested above LHA

26. Stewart ANG, NY
City of Newburgh drinking water reservoir above LHA. AF negotiating a cooperative agreement; pending legal review

Current as of 12 October 2017

Public Drinking Water Notice
Health Advisory

Under the Safe Drinking Water Act, the Environmental Office monitors the quality of water removed from each of the supply wells used to provide your water. We sample each well routinely for substances for which the United States Environmental Protection Agency ("EPA") or Pennsylvania Department of Environmental Protection ("DEP") have set primary or secondary drinking water standards.

Recently, samples were taken in association with ground water monitoring onsite and in other nearby public water supplies that indicated the probable presence of these chemicals in the base public water system drinking water wells.

On August 22, 2014, we received notice that samples collected from bldg. 204, Horsham Air Guard Station, exceeded the federal provisional health advisory for Perfluorooctane Sulfonate (PFOS) and Perfluorooctanoic acid (PFOA). The results for PFOS were found to be 11.9 micrograms per liter (ug/l) and PFOA to be 3.28 ug/l. Research is continuing on these unregulated contaminants, however, EPA established a provisional HAL for PFOS at 0.2 micrograms per liter (µg/l) and PFOA at 0.4 micrograms per liter (µg/l). One microgram per liter is equivalent to one part per billion ("ppb").

After consulting with DEP, Horsham Air Guard station decided to take action by shutting off all water (drinking) fountains. Food Service personnel will use alternate means of food preparation. Additionally, bottled water will be supplied to personnel assigned to the 111th Attack Wing. Horsham Air Guard Station tenants will coordinate the supply of bottled water through their respective agency. We will continue to work with DEP and EPA in monitoring the situation and notify personnel of any changes.

You can visit EPA's website for more information about provisional HALs at the following website: http://water.epa.gov/drink/standards/hascience.cfm#pfoa.

Point of Contact for Horsham Air Guard Station: Lt Col Jacqueline Siciliano, 1051 Fairchild Street, Horsham Air Guard Station, PA 19044-5203, COMM: 215-323-8387.

What happened?

Groundwater contamination has been identified on and in the area of Willow Grove Naval Air Station Joint Reserve Base (NAS/JRB). Other wells have been impacted and also exceed the provisional health advisory levels for PFOS and PFOA. It is possible that the presence of PFOS and PFOA in the groundwater is related to historic activities on the Base. The Impacts on groundwater associated with Base operations is not a new condition and has been investigated in in the past and is in the process of being addressed; however the presence of PFOS and PFOA in drinking water on the Base has only very recently been identified.

What are PFOS and PFOA?

PFOS and PFOA are organic chemicals used as stain, water, oil, and grease repellents for both water soluble and fat soluble materials. PFOS and PFOA were first used in the 1950s. They have been used in a variety of products such as the fabric of upholstered furniture, carpets, nonstick cookware, floor wax, and the lining of microwave popcorn bags. These chemicals are widely distributed in the environment and have been found in the blood of humans, wildlife, and fish.

MICHAEL F. BENNET
COLORADO

COMMITTEES:
AGRICULTURE, NUTRITION, AND FORESTRY

FINANCE

HEALTH, EDUCATION, LABOR, AND PENSIONS

United States Senate

WASHINGTON, DC 20510–0609

August 31, 2017

WASHINGTON, DC:
458 RUSSELL SENATE OFFICE BUILDING
WASHINGTON, DC 20510
(202) 224-5852

COLORADO:
1127 SHERMAN STREET
SUITE 150
DENVER, CO 80203-2398
(303) 455-7600

http://www.bennet.senate.gov

The Honorable Thad Cochran
Chairman
Committee on Appropriations
Room S-128, The Capitol
Washington, D.C. 20510

The Honorable Patrick Leahy
Vice Chairman
Committee on Appropriations
Room S-128, The Capitol
Washington, D.C. 20510

Dear Chairman Cochran and Vice Chairman Leahy:

As the Senate Appropriations Committee continues to advance appropriations bills for Fiscal Year 2018 (FY18), we urge your support for programs that address the unregulated and emerging water contaminant per- and polyfluoroalkyl substances (PFAS). These chemicals are components of aqueous film forming foam (AFFF), a firefighting agent used by the military services and civilian entities, and are being detected in drinking water sources across the nation.

In 2016, the Environmental Protection Agency (EPA) established new lifetime health advisories for two PFAS known as PFOA and PFOS. The Department of Defense (DOD) has already identified approximately 400 installations with a known or suspected release of PFOS/PFOA that requires additional investigation. While the risks associated with PFAS exposure are still being uncovered, studies have linked these chemicals to developmental effects, cancer and immune system dysfunction. Residents of our states are concerned about exposure to these chemicals, and what this means for their health and safety.

The National Defense Authorization Act (NDAA) for FY18 (S.1519), as passed by the Senate Armed Services Committee (SASC), authorizes a study led by the Centers for Disease Control, with support from the EPA and DOD, on the health effects, and cumulative impact of PFAS contamination in drinking water, groundwater, and other relevant exposure pathways. We request the Committee include the necessary funding for such a study.

The scope of contamination is also just beginning to be understood. DOD is conducting preliminary site inspections in some areas and residents are eagerly awaiting remediation and water treatment efforts. Nationwide, DOD officials have suggested that clean up costs could reach as high as $2 billion. We urge the Committee to include language directing DOD and the military services to budget robustly for assessment, investigation, and remediation activities in the upcoming fiscal years.

Additionally, the SASC-passed NDAA FY18 authorizes increased funding for the Strategic Environmental Research and Development Program and the Environmental Security Technology Certification Program to address the safety and welfare of servicemembers and their dependents by eliminating the current generation of contaminants and by reducing the cost of remediation

efforts. We urge you to include similar investments, including for research into firefighting alternatives that do not contain PFAS and that meet military specification performance standards.

Thank you for your consideration of our request. We look forward to working closely with you on this issue.

Sincerely,

Michael F. Bennet
United States Senator

Jeanne Shaheen
United States Senator

Patty Murray
United States Senator

Kirsten Gillibrand
United States Senator

Robert P. Casey Jr.
United States Senator

Margaret Wood Hassan
United States Senator

Maria Cantwell
United States Senator