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IX. Statutory and Executive Order Reviews

This action is a significant regulatory action that was submitted to the Office of Management and Budget (OMB) for review under Executive Order 12866, entitled "Regulatory Planning and Review" (58 FR 51735, October 4, 1993). Any changes made in response to OMB recommendations have been documented in the docket for this action. Because this action does not propose or impose any requirements, and instead seeks comments and suggestions for the Agency to consider in possibly developing a subsequent proposed rule, the various statutes and Executive Orders that normally apply to rulemaking do not apply in this case. Should EPA subsequently determine to pursue a rulemaking, EPA will address the statutes and Executive Orders as applicable to that rulemaking.

List of Subjects in 40 CFR Part 372

Environmental protection, Community right-to-know, Reporting and recordkeeping requirements, and Toxic chemicals.

Dated: November 25, 2019.

Andrew R. Wheeler,

Administrator.

[FR Doc. 2019–26034 Filed 12–3–19; 8:45 am]

BILLING CODE 6560–50–P

McDougall, Robert

From: Bereket Tesfu <btesfu@naag.org>
Sent: Thursday, January 30, 2020 1:47 PM
Subject: FW: [PFAS ACTION ITEM] *January 2* NAAG national environmental conference call
Attachments: 2020 01 30 Comments_ANPR PFAS TRI (draft).docx

Importance: High

EXTERNAL SENDER: Do not open attachments or click on links unless you recognize and trust the sender.

UPDATE: **The deadline for signatures has been extended to tomorrow (Friday, January 31.)** 11 states have signed on to the letter so far with several other states still seeking approval. Attached to this e-mail is a new draft responsive to feedback from the states.

If anyone wants to directly reach Philip Bein about the letter, he can be contacted at Philip.Bein@ag.ny.gov

For more details on the current status of the letter, please see the e-mail below.

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From: Desai, Mihir <Mihir.Desai@ag.ny.gov>
Sent: Thursday, January 30, 2020 12:07 PM
To: Bereket Tesfu <btesfu@naag.org>
Cc: Bein, Philip <Philip.Bein@ag.ny.gov>
Subject: RE: [PFAS ACTION ITEM] *January 2* NAAG national environmental conference call

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Good morning, Bereket. Thank you again for your extremely helpful coordination of the states on the PFAS TRI letter. Presently, we have 11 states (including NY) that have signed onto the letter, with several others who are seeking approvals.

We would appreciate if you might circulate the attached draft that reflects many good comments we've received from the states. We are working with some states to address a few specific points. Also, we are still open to having states join the letter if they can provide signatures by tomorrow.

Best,
Mihir

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From: Bereket Tesfu <btesfu@naag.org>
Sent: Tuesday, January 28, 2020 1:54 PM
Subject: RE: [PFAS ACTION ITEM] *January 2* NAAG national environmental conference call
Importance: High

[EXTERNAL]

Just one last reminder, the deadline for signatures is tomorrow (Wednesday, January 29).

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From: Bereket Tesfu
Sent: Wednesday, January 22, 2020 5:23 PM
To: Bereket Tesfu <btesfu@naag.org>
Subject: RE: [PFAS ACTION ITEM] *January 2* NAAG national environmental conference call
Importance: High

Hello, all. Following up on the e-mail below and the subsequent January conference call, attached is the much-anticipated draft letter from the New York Attorney General's office pertaining to comments on adding PFASs to the Toxics Release Inventory (TRI). (Also attached is the EPA's advanced notice of proposed rulemaking.) Here is a note from Philip Bein pertaining to the attached draft letter:

"Attached is the NYAG's draft for the comment letter on adding PFASs to the Toxics Release Inventory. When you distribute please inform the other AG offices that the end notes are incomplete and we are still working on them. We would like to receive any comments on the draft and sign on by January 29."

Because the EPA deadline to submit comments is **February 3**, and it took longer than expected to put the draft letter together, *time is of the essence* from here on out to meet New York's internal deadline of **January 29** for signatures.

If another conference call is necessary between now and January 29 to discuss the draft letter, I'm more than happy to facilitate that. Please let me know.

If anyone wants to directly reach Philip Bein, he can be contacted at Philip.Bein@ag.ny.gov.

If you

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From: Bereket Tesfu
Sent: Monday, December 30, 2019 12:19 PM
Subject: [PFAS ACTION ITEM] *January 2* NAAG national environmental conference call
Importance: High

Hello, everyone. I hope you've been enjoying the holidays. An imminent PFAS action item has arisen that can be addressed on the call this week.

I received the following message from the New York Attorney General's Office:

"State Comments on Rulemaking for Inclusion of PFAS in Toxics Release Inventory

On December 3, 2019, EPA published an advance notice of proposed rulemaking (ANPRM) soliciting comments from the public concerning a possible future rule that would add PFAS to the toxics release inventory (TRI), the list of toxic chemicals subject to reporting under Section 313 of the Emergency Planning and Community Right-to- Know Act (EPCRA). A copy of the ANPRM is attached. In addition, the National Defense Authorization Act for Fiscal Year 2020 (NDAA) was passed just days ago. It amends EPCRA by adding various PFAS chemicals to the TRI and by providing for assessment of other PFAS for possible future inclusion. New York believes that the NDAA is an important step forward in including PFAS chemicals on the list so that releases of such chemicals by facilities can be tracked and reported. However, the State believes that the entire class of PFAS chemicals should be included in the TRI. New York is developing comments proposing to add that class to the TRI and wants to solicit other states to join in these comments."

The Federal Register advanced notice is attached to this e-mail. **Comments are due by February 3, 2020**, so the call this week may be the last reasonable opportunity to have as many states as possible in one forum to have a discussion on this issue and possibly coordinate from it.

If you have any other proposed agenda items, please send them my way.

To access the conference call on **January 2, 2020, at 1:00 p.m. (ET)**, call in to [redacted] and use the **pass code** [redacted] *The conference call will open with a roll call of states*. Once the substantive discussions begin, we ask that participants identify themselves by name and state so we can know who's speaking.

*****We kindly ask that this invitation or any information about this call not be forwarded to or shared with anyone beyond the attorney general community. This request is to ensure that those who participate on this call are only those who work on environmental matters for their respective attorney general offices. This conference call is not for industry, the press, or the general public.*****

We look forward to you joining us on January 2.

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The Attorneys General of the States of New York, Connecticut, Delaware, Illinois, Iowa, Maine, Massachusetts, Michigan, Oregon, Rhode Island, and Wisconsin [*INSERT OTHERS]

February 3, 2020

Via Regulations.gov and First Class Mail
Document Control Office (7407M)
Office of Pollution Prevention and Toxics (OPPT)
Environmental Protection Agency
1200 Pennsylvania Ave. NW
Washington, D.C. 20460-0001

Re: Comments on the Advance Notice of Proposed Rulemaking, *Addition of Certain Per- and Polyfluoroalkyl Substances; Community Right-to-Know Toxic Chemical Release Reporting*, 84 Fed. Reg. 66369 (Dec. 4, 2019)

Docket ID No. EPA-HQ-TRI-2019-0375

Dear Administrator Wheeler:

The state attorneys general of New York, Connecticut, Delaware, Illinois, Iowa, Maine, Massachusetts, Michigan, Oregon, Rhode Island, and Wisconsin [*list other states] (the Attorneys General) appreciate the opportunity to offer comments on the Environmental Protection Agency's (EPA) Advance Notice of Proposed Rulemaking, *Addition of Certain Per- and Polyfluoroalkyl Substances; Community Right-to-Know Toxic Chemical Release* Reporting (ANPRM), which requests public comments "on which, if any, PFAS should be evaluated for listing [on the Toxics Release Inventory], how to list them, and what would be appropriate reporting thresholds given their persistence and bioaccumulation potential." 84 Fed. Reg. 66369 (Dec. 4, 2019). More specifically, EPA seeks comments on "which of the approximately 600 PFAS currently active in U.S. commerce the Agency should consider evaluating for potential addition to the [Toxics Release Inventory]," and on "whether there are data available to inform how to list PFAS, *i.e.*, as individual chemical listings, as a single category, as multiple categories or as a combination of individual listings and category listings." 84 Fed. Reg. at 66372.

As discussed below, we strongly support an EPA rulemaking to list *per*-fluoroalkyl and *poly*-fluoroalkyl substances (PFASs) on the Toxics Release Inventory (TRI) both as a single category listing for all PFASs and as individual listings for specific compounds in the category. Considerable information is already known that demonstrates the acute and chronic harms that certain PFASs pose to human health, their persistence and bioaccumulation, and the significant adverse effects PFAS contamination causes to the environment. Because those PFASs share chemical similarities with members of the PFAS class, each individual PFAS "can reasonably be anticipated to cause" acute and/or chronic harms to human health and adverse effects to the environment for purposes of adding them under EPA's TRI Program. Reporting of these chemicals under the Emergency Planning and Community Right to Know Act (EPCRA) and the Pollution Prevention Act (PPA), is feasible because validated and commonly-accepted methods exist to measure the levels of these PFASs.

In addition, as described below, the Attorneys General recommend that EPA set a TRI reporting threshold of one pound for PFAS as a category class, as well as for individual PFAS chemicals.

Background

PFASs

PFASs are known as "forever chemicals" because they resist degradation and are persistent in the environment. PFASs have been incorporated into countless consumer products since the 1940s, including textiles treated with Scotchgard, cookware lined with Teflon, and food packaging, among numerous other products and uses. In addition, for decades, PFASs have also been incorporated into firefighting foam used across the country, including by the U.S. military and local fire departments. As the ANPRM points out, PFASs present a risk of harm to the environment and to human health, and numerous PFASs have been found in human blood. PFASs also bioaccumulate and are toxic to humans and animals. PFASs are linked to serious adverse health effects in humans and animals, including reproductive, developmental, liver, immune, thyroid, cancer, and other effects.

The Emergency Planning and Community Right-to-Know Act (1986) and the Pollution Prevention Act (1990)

Congress created the TRI Program as part of its response to serious chemical releases in the 1980s from Union Carbide facilities in Bhopal, India, and Institute, West Virginia. Through EPCRA, and later, PPA, Congress sought to support and promote emergency planning and to provide the public with information about releases of toxic chemicals in their communities.

The TRI Program serves an essential function by providing information to federal, state, and local governments about releases of toxic chemicals to the environment, incentivizing companies to improve their environmental performance, and aiding in the development of appropriate regulations, guidelines, and standards for managing toxic chemicals. 42 U.S.C. §11023(h). Section 313 of EPCRA requires certain federal and industrial facilities that manufacture, process, or otherwise use chemicals listed in the TRI above threshold quantities to report, on an annual basis, the amounts of these chemicals released into the environment and otherwise managed as waste. 42 U.S.C. § 11023. Likewise, the PPA requires regulated facilities to report pollution prevention and recycling data for chemicals on the TRI. 42 U.S.C. § 13106.

Chemicals are included on the TRI by statute or by EPA designation. EPCRA authorizes EPA to add a chemical or a class of chemicals to the TRI based on evidence that the chemical or class is "known to cause or can reasonably be anticipated to cause" acute or chronic adverse human health effects or significant adverse environmental effects. 42 U.S.C. § 11023(d)(2).

The National Defense Authorization Act for Fiscal Year 2020 (NDAA)

In December 2019, Congress amended EPCRA through certain provisions of the NDAA by adding certain individual PFAS chemicals to the TRI Program. NDAA, Pub. Law 116-92 (December 20, 2019). The listed PFASs include PFOA, PFOS, GenX, PFNA, and PFHxS, certain associated salts and other compounds, as well as approximately 150 other PFASs listed under other statutes and regulations.[1] *Id.*, § 7321(b)(1). The NDAA also amends EPCRA by establishing a reporting threshold for these PFASs of 100 pounds. *Id.*, § 7321(b)(2). The NDAA also provides for the possible future inclusion of other PFASs into the TRI. *Id.*, § 7321(c).

* * *

The Attorneys General commend Congress for enacting the NDAA. We believe that the NDAA is important because it includes PFAS chemicals on the TRI so that governments, communities, and regulated companies themselves can engage in informed decision-making about the management of such chemicals during their lifecycles at covered facilities. This information is especially important to the state governments we represent because states commonly bear the brunt of remediation costs when chemicals like PFASs are mismanaged or discharged to the environment.

As described below, the Attorneys General urge EPA to proceed now with a rulemaking to cover the entire family of PFASs, along with certain individual PFAS chemicals, each with a reporting threshold of one pound. Our recommendations below echo those conveyed in a July 2019 letter sent by twenty-two state attorneys general, including many of the undersigned, to the U.S. congressional leadership (July 30, 2019 Attorneys General Letter to Congress).[2] Among other things, the letter requested the addition of the entire class of PFASs to the TRI to help identify new potential sources and areas of contamination, at a very low reporting level. As intended by the TRI Program, the actions we recommend below will provide the public with vital needed information about releases of PFASs in their communities.

Recommendations

We respectfully make the following recommendations:

Recommendation 1:

Add all PFASs to the TRI Program as a single category listing.

EPA should include all PFASs, as a class, to the TRI Program. This recommendation applies to the entire category of PFASs, potentially consisting of thousands to more than 10,000 individual chemicals, including the approximately 600 PFASs that the ANPRM states are deemed active in U.S. commerce. Including all PFASs in the TRI Program would account for the very many PFASs that, though not purposefully manufactured for commercial use, are nevertheless constituents of commercial products. The class of PFASs satisfies EPCRA's listing criteria because all PFASs have similar chemical properties that are "known to cause or can reasonably be anticipated to cause" acute and/or chronic harm to human health and significant adverse effects to the environment. EPCRA, section 313(d)(2).[3]

Certain PFASs that were commonly used in commerce in our states, including *per*-fluoroalkyl carboxylates (such as PFOA) and *per*-fluoroalkyl sulfonates (such as PFOS), can show similar indicia of toxicity, persistence in the environment, and tendency to accumulate ubiquitously in the environment and in biota.[4] Increasingly, industry is substituting *poly*-fluoroalkyl substances for *per*-fluoroalkyl substances, which have been used more traditionally in all manner of consumer products. However, some *poly*-fluoroalkyl substances can readily break down or transform to both *per*-fluoroalkyl carboxylates and sulfonates whose toxicity, persistence, and bioaccumulation are well-known.[5] In addition, ultra-short chain PFASs, *i.e.* those with a backbone of less than four carbon molecules, may pose a similar risk to human health and the environment as longer chain PFASs such as PFOA and PFOS. Specifically, these shorter-chain PFASs may share similar characteristics with longer-chain PFASs, including a high degree of fluorination, lack of known degradation mechanism, confirmed environmental occurrence and ubiquity, and reasonably assumed health-based toxicological endpoints.[6] A class-based approach for assessing PFASs is recommended by federal experts, for example, Dr. Linda Birnbaum, Director of the National Institute of Environmental Health Sciences and the National Toxicology Program.[7]

Though not a criterion for listing, it is notable that commonly used and widely accepted commercial techniques are available to identify and quantify short- and long-chain PFAS compounds. Likewise, total and ultra-short PFAS concentrations can be readily estimated using a combination of commercially available analytical techniques.[8]

EPA has ample experience listing chemical classes as a single category in the TRI Program. For example, the TRI lists all polychlorinated biphenyls (PCBs), a diverse family of compounds, as a single category. EPA has appropriately done so despite the chemical-specific differences in health-based impacts, as well as environmental fate and transport processes, among individual PCBs. PCBs provide an especially helpful example here as they tend to bioaccumulate or demonstrate harm to humans and animals at many of the same health-based endpoints as PFASs, including liver, thyroid, immunological alterations, neuro-developmental changes, reduced birth weight, reproductive toxicity, and cancer.[9] In addition, like many PFASs, PCBs are known to be persistent, bioaccumulative, and toxic.

Finally, EPA should adopt a chemical class-based approach for listing PFASs on the TRI because it will provide critical information to enable the states, other regulators, and facility operators to better understand the extent that PFASs are used at regulated facilities and the potential for their release into the environment. As a result, existing and future waste streams containing PFASs can be appropriately managed, remediated, and regulated, and uncontrolled releases can better be prevented to avoid adverse impacts to public health and the environment. While cost is not a regulatory criteria for adding chemicals to the TRI, it is worth noting that the cost to facilities of reporting on PFASs can be offset by the benefits of reducing environmental releases of these chemicals.

Recommendation 2:

Add specific PFASs to the TRI Program as individual listings to the extent that: (1) EPA has validated a method to measure the level of each PFAS; and (2) the chemical is not already listed pursuant to the NDAA.

In addition to listing all PFASs to the TRI as a class, EPA should add the following twenty individual PFAS chemicals to the TRI Program as individual listings: PFBS, PFPeS, PFHpS, PFBA, PFPeA, PFHxA, PFHpA, PFUnA, PFTrDA, 11Cl-PF3OUdS, 9Cl-PF3ONS, ADONA, 4:2FTS, 8:2FTS, NFDHA, PFEESA, PFMBA, PFMPA, NEtFOSAA, and NMeFOSAA. The toxicity of PFOA and PFOS, the most studied PFASs to date, to humans and the environment is well known. The recently enacted NDAA added many PFASs to the TRI. Our recommendation would supplement the TRI with additional PFASs.

The proposed twenty additional PFASs may be reasonably anticipated to share some or all of the same hallmarks of persistence, bioaccumulation, and/or toxicity to humans as those already added to the TRI Program through the NDAA, with similar health-based effects at comparable exposure endpoints.[10] Like PFASs with well-known human health and environmental impacts, these additional PFASs may also be anticipated to breakdown into other PFASs whose adverse effects are known and/or to accumulate in the environment with wide-ranging contamination in air, water, soil, and multiple biological tissues.[11] Although not a criterion for listing to the TRI, the chemicals we propose adding are readily measurable using validated analytical methods.[12]

These twenty individual PFASs easily meet EPCRA's criteria for listing on the TRI Program. Consistent with the approach implemented by Congress under the NDAA, these individual PFASs should be listed, along with their salt forms and other closely-related chemicals (*e.g.*, linear and branched isomers).

Recommendation 3:

The TRI Threshold Reporting Limit should be one pound for both individual PFAS chemicals and for the PFAS chemical compound category.

EPCRA establishes general reporting thresholds of 25,000 pounds for facilities involved in manufacturing or processing listed chemicals, and 10,000 pounds for facilities that otherwise use listed chemicals. As the ANPRM notes, however, in the past EPA has established lower reporting thresholds for listed chemicals of special concern. 84 Fed. Reg. at 66371. EPA has lowered reporting thresholds for persistent, bioaccumulative, and toxic (PBT) chemicals and chemical compound categories, and in particular, for PBTs with very high persistence and bioaccumulation values. 84 Fed. Reg. at 66371.

As discussed above, PFASs are well-understood to be highly persistent and bioaccumulative chemicals. Consequently, EPA should add the compound category of PFASs as well as all individually-listed PFASs to the list of chemicals of special concern, 40 C.F.R. § 372.28. Given the high potential of PFASs to cause acute and chronic harm to humans and biota, in addition to their high persistence and bioaccumulative tendencies, the Attorneys General recommend that EPA set a threshold reporting requirement of one pound for the PFAS compound class and for each individual PFAS chemical, including the PFASs that the NDAA added to the TRI at a reporting threshold of 100 pounds.

A lower reporting threshold for PFASs would be consistent with past EPA decisions regarding PBT chemicals. In the past, EPA lowered the threshold reporting requirements for sixteen PBT chemicals and five PBT categories due to the insidious threats PBTs pose to human health and the environment compared to other chemicals in the TRI.[13] Of these, EPA has set reporting thresholds of ten pounds for ten PBT chemicals and one PBT category. Furthermore, EPA lowered the reporting threshold for the PBT chemical compound category of Dioxin and Dioxin-Like Compounds, to one tenth of a gram, which is only 0.0002205 pounds.[14]

A reporting threshold of one pound for the chemical compound category of PFASs and for individual PFAS chemicals is appropriate and warranted. For PCBs, a category of 209 individual PBT chemical compounds, EPA established an updated TRI reporting threshold of ten pounds in 1999. Health advisories recommended by EPA for some PFASs, as well as standards proposed or adopted by numerous states, are an order of magnitude lower for PFASs than for PCBs. Thus, applying the same ratio, the TRI reporting threshold for PFASs should be an order of magnitude lower than for PCBs, *i.e.*, one pound.[15]

Significantly, studies by the U.S. Department of Health and Human Services Agency for Toxic Substances and Disease Registry (ATSDR) also support a one-pound reporting threshold for PFASs. ATSDR derived a health-based screening level for total PCBs and has proposed draft health-based screening levels for four individual PFASs which are at or an order of magnitude lower than the health-based screening levels previously established for PCBs.[16] This also justifies setting a reporting threshold for PFASs at one pound, roughly an order of magnitude lower than the ten-pound reporting threshold for PCBs.

Conclusion

The Attorneys General appreciate this opportunity to comment on the ANPRM relating to the listing of PFASs to the agency's TRI Program, and respectfully request a future rulemaking that incorporates our recommendations.

Sincerely,

FOR THE STATE OF NEW YORK

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End Notes

[1] Section 7321 of the NDAA specifically added fourteen PFASs for addition to the TRI list. The NDAA also added 158 PFAS chemicals, including twelve of those specifically added, that met two criteria: (1) they were subject to a significant new use rule at either 40 CFR 721.9582 or 721.10536 on or before December 20, 2019; and (2) they were identified as active in commerce on the Toxic Substances Control Act (TSCA) Inventory that was published in February 2019 (EPA 2020a).

[2] July 30, 2019 Attorneys General Letter to United States Congressional leadership regarding PFAS legislation (Attorneys General 2019).

[3] For clarity, we take no position as to whether a maximum contaminant level (MCL) for PFASs, as a class, should be established under either federal law or the law of any state, as adding PFASs to the TRI and establishing an MCL may involve different considerations.

[4] Comparison of toxicity for perfluoroalkyl substances is complicated due to limited studies, differences between genders, across species, and in mechanism of endpoint for specific chemicals, however, similarities exist in terms of association of specific health risks to multiple chemicals within the PFASs family. Suggested associations in humans include pregnancy-induced hypertension (PFOA and PFOS), hepatic effects (PFOA, PFOS and PFHxS), cholesterol effects (PFOA, PFOS, PNFA and PFDA), thyroid disease (PFOA and PFOS), antibody response (PFOA, PFOS, PFHxS and PFDA), asthma (PFOA), developmental effects (PFOA and PFOS) and death (PFOA and PFOS) (ATSDR 2018). Multiple replacement PFASs (6:2 chlorinated polyfluorinated ether sulfonate (6:2 Cl-PFESA), HFPO trimer acid (HFPO-TA), HFPO tetramer acid (HFPO-TeA), and 6:2 fluorotelomer sulfonic acid (6:2 FTS)) have been shown to have greater toxic effects on the human liver HL-7702 cell line, as compared to PFOA and PFOS (Sheng et al. 2018a).

ATSDR reviewed 187 animal studies and found that primary effects from exposure to perfluoroalkyl substances included hepatic (PFOA, PFOS, PFBA, PFHxA, PFHpA, PFNA, PFDA, PFUnA, PFDoA, PFBS and PFHxS), developmental (PFOA, PFOS, PFBA, PFHxA, PFNA, PFDA, PFUnA, PFDoA and PFHxS), and immune toxicity (PFOA, PFOS), though not all effects were observed or examined for the fourteen PFASs ATSDR evaluated. Additional effects were also found in laboratory animals relating to the kidney (PFHxA, PFUnA, PFBS and PFHxS), thyroid functioning (PFBA and PFHxS), and death (PFHxA, PFNA and PFDA) (ATSDR 2018). Compared to PFOA, HFPO-TA showed greater liver toxicity and bioaccumulation potential in mice (Sheng et al. 2018b).

Human biomonitoring of blood from European citizens showed PFOA and PFOS levels in blood are decreasing, but levels of novel PFASs are increasing (EEA 2019). In 2009 EPA released an action plan on long-chain PFAS (including perfluoroalkyl sulfonates with six or more carbons (PFHxS and higher homologues) and perfluoroalkyl carboxylates with eight or more carbons (PFOA and high homologues), as well as their salts and precursors), noting long-chains are a concern for children's health, that children have greater exposure than adults, and that "it can reasonably be anticipated that continued exposure could increase body burdens to levels that would result in adverse outcomes" (EPA 2009). The simplest endpoint of all PFASs within the perfluoroalkyl carboxylate family is trifluoroacetic acid (TFA), which is resistant to further degradation, miscible in water, not metabolized in mammalian systems, and can cause liver effects (Boutonnet et al. 1999). Though health-based toxicological effects vary for individual PFASs in humans or animals, the range of different types of effects for PFASs as a family combined with the similarity of effects for multiple perfluoroalkyl carboxylates and perfluoroalkyl sulfonates warrants attention to and reporting of the whole family of PFASs in the TRI.

PFASs that have been found in the environment (air, water, solids, biota) include all the routinely analyzed perfluoroalkyl carboxylates (four to fourteen carbons; PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFNA, PFDA, PFUnA, PFDoA, PFTrDA, PFTeDA), all of the routinely analyzed perfluoroalkyl sulfonates (four to ten carbons; PFBS, PFPeS, PFHxS, PFHpS, PFOS, PFNS, PFDS), as well as dozens of other PFASs (Rubarth et al. 2011; MIDHHS 2018; NCDEQ 2018; Song et al. 2018; Johnson 2018a; EPA 2019a; MacGillivray 2019; EPA 2019b). New Jersey sampled surface water, sediments and fish and found that PFASs occur as a mixture in those three media; predominately shorter chain PFASs were found in water and longer chain PFASs were found in sediments and fish (NJDEP 2018). Compared to PFOA or PFOS numerous other PFASs were found in New York, co-located and at equivalent or higher concentrations in either soil, water or fish (Richter and Skinner 2017; Johnson 2018a; Johnson 2018b; Richter and Becker 2018; Becker et al. 2019; Becker 2019; Edwards 2019).

[5] ATSDR summarized relevant research for the perfluoroalkyls they evaluated; human exposure may occur from all contaminated media (air, water, soil, and food), they are very stable in the environment, are persistent in soil and leach into groundwater, and have been detected in oceans and the Arctic, demonstrating the potential for long-range transport (ATSDR 2018). Polyfluoroalkyl substances (precursors) are known to break down or transform to perfluoroalkyl substances (such as perfluoroalkyl carboxylates and perfluoroalkyl sulfonates) due to natural and/or anthropogenically induced industrial, environmental, or metabolic conditions (Buck et al. 2011; CONCAWE 2016). Perfluoroalkyl carboxylates are the terminal degradation (biotic and abiotic) product for numerous families of polyfluoroalkyl substances (Buck et al. 2011). Polyfluoroalkyl substances represent, at a minimum, the same toxicological threat as the endpoint perfluoroalkyl substances which they may degrade or transform in to.

[6] In addition to the routinely analyzed PFASs which are quantified using targeted analysis (LC-MS-MS), non-routine analysis techniques have been used by EPA as well as other researchers to identify thousands of other novel PFASs, including ultra-short-chains, in the environment or at manufacturing sites (EPA 2018). High concentrations (up to tens of parts per billion), of ultra-short-chain perfluoroalkyl carboxylates (TFA and perfluoropropionic acid (PFPrA)) and perfluoroalkyl sulfonates (trifluoromethane sulfonic acid (TFMS), perfluoroethane sulfonic acid (PFEtS), and perfluoropropane sulfonic acid (PFPrS)) were found near suspected point sources in Sweden, representing up to 69% of the total PFASs concentration measured (twenty-nine chemicals) (Björnsdotter et al. 2019). PFEtS and PFPrS have been measured in aqueous film-forming foam (AFFF) (up to 13,000,000 ng/L and 270,000,000 ng/L, respectively), as well as in groundwater from U.S. military bases (up to 7,500 ng/L and 63,000 ng/L, respectively) (Barzen-Hanson and Field 2015). Ultra-short-chain PFASs can also be generated from the breakdown or transformation of longer chain PFASs.

The simplest perfluoroalkyl carboxylate, TFA, as well as other ultra-short-, short-, and long-chain perfluoroalkyl carboxylates (PFPrA, PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFNA, PFDA, PFUnA, PFDoA, PFTeDA and PFTrDA), are generated from thermal decomposition of polymers (Ellis et al. 2001). EPA Office of Research and Development (ORD) used non-routine analysis to collect in-situ emission samples from a sintering oven used at a manufacturing facility in New York, and found that though no PFOA nor other long-chain PFASs were detected, qualitative characterization of PFASs revealed low process emissions of PFBA, ultra-short-chain perfluoroalkyl carboxylates (TFA and PFPrA), and polyfluoroalkyl substances (4:2 FTOH and fifteen others) (Gentile 2019; EPA 2019b). ORD also found PFPrA, as well as eighty-eight other PFASs, in process emissions from a PFAS manufacturing site in New Hampshire (EPA 2019a). No PFPrA, nor other perfluoroalkyl carboxylates, were present in the raw products which were tested from the site (EPA 2019c). Although not measured in the dispersions or surfactants, it is likely that, based on detected analytes and the qualitative peak concentrations for air emissions and dispersions, the perfluoroalkyl carboxylates measured in air emissions were generated from manufacturing processes which used stock industrial dispersions and surfactants.

[7] "Approaching PFAS as a class for assessing exposure and biological impact is the best way to protect public health." Testimony of Linda S. Birnbaum at hearing on "The Federal Role in the Toxic PFAS Chemical Crisis" before the Senate Committee on Homeland Security and Governmental Affairs and Subcommittee on Federal Spending Oversight and Emergency Management (Birnbaum 2018).

[8] Analytical techniques (non-targeted and non-routine analysis) have been developed to aid in identification of the presence and chemical formula of unknown PFASs, however the lack of available standards for these chemicals limits the ability to quantitate the chemicals based on currently promulgated analytical methods. PFASs which are able to transform to perfluoroalkyls (precursors) in the environment are quantified using a commercially developed method, the Total Oxidizable Precursor Assay (Buechler 2017). Other commercial techniques have been developed which are able to quantitatively report total organofluorine, a proxy of total PFASs (Eurofins 2018).

[9] ATSDR derived a Minimal Risk Level (MRL) of 0.02 μg/kg/day for PCBs as a family of chemicals. While setting the MRL ATSDR noted that for either humans or animals, health effects associated with PCB mixtures included liver, thyroid, dermal and ocular changes, immunological alterations, neurodevelopmental changes, reduced birth weight, reproductive toxicity and cancer (ATSDR 2000).

[10] PFASs that have been found in humans, or which have had health-based advisory values or standards set for drinking water, include all of the routinely analyzed perfluoroalkyl carboxylates (four to fourteen carbons; PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFNA, PFDA, PFUnA, PFDoA, PFTrDA, PFTeDA), and all of the routinely analyzed perfluoroalkyl sulfonates (four to ten carbons; PFBS, PFPeS, PFHxS, PFHpS, PFOS, PFNS, PFDS). Other PFASs have also been found in humans or have health-based advisory values, including PFASs which are routinely analyzed (FOSA, 6:2 FTS, 8:2 FTS, GenX, N-MeFOSAA, N-EtFOSAA) and numerous other chemicals which are not, or are newly, routinely analyzed, including both perfluoroalkyl (perfluoroalkyl carboxylates (sixteen and eighteen carbons; PFHxDA and PFOcDA) and perfluoroalkyl phosphinic acids (PFPiAs)) and polyfluoroalkyl substances (polyfluoroalkyl phosphoric diesters (diPAPs), fluorotelomer alcohols (FTOH), fluorotelomer unsaturated carboxylic acids (FTUCAs; 6:2, 8:2, and 10:2), fluorotelomer carboxylic acids (FTCAs; 5:3 and 7:3) and perfluoroalkyl sulfonate derivatives – Cl-PFOS, Cl-PFHxS, ketone-PFOS, ether-PFHxS) (ITRC 2020; ATSDR 2018; CA 2015; EPA 2009). End Note four discusses similar exposure endpoints for health-based effects from PFASs.

[11] See End Notes four, five and six.

[12] EPA's validated Method 533 (November 2019) focuses on short chain PFASs and complements EPA Method 537.1 (November 2018). Using both methods, a total of twenty-nine unique PFASs can be effectively quantified in drinking water, the only media for which EPA has released validated methods of analysis. Of these, we recommend that EPA add to the TRI Program the twenty PFASs that have not already been listed under the NDAA, *i.e.* PFBS, PFPeS, PFHpS, PFBA, PFPeA, PFHxA, PFHpA, PFUnA, PFTrDA, 11Cl-PF3OUdS, 9Cl-PF3ONS, ADONA, 4:2FTS, 8:2FTS, NFDHA, PFEESA, PFMBA, PFMPA, NEtFOSAA, and NMeFOSAA (EPA 2019d).

[13] The reporting threshold for PCBs under the TRI was lowered to ten pounds in 1999, when EPA promulgated the Final Rule on Persistent, Bioaccumulative, and Toxic (PBT) chemicals (EPA 2019e).

[14] There are sixteen PBT chemicals and five PBT chemical compound categories that are subject to TRI reporting (EPA 2020b).

[15] An MCL is the maximum concentration of a chemical in drinking water and has the force of law under the federal Safe Drinking Water Act. The federal MCL for PCBs is 500 parts per trillion (ppt). No federal MCLs have been set for PFASs, but a health advisory (HA) for PFOA/PFOS of 70 ppt has

been established by EPA for drinking water. Although lacking the force of law, a HA is analogous to a MCL. The 70 ppt HA for PFOA/PFOS is roughly an order of magnitude lower than the 500 ppt MCL for PCBs, justifying setting a reporting threshold for PFASs at one pound, roughly an order of magnitude lower than the ten pound reporting threshold for PCBs.

[16] ATSDR derived a health-based screening level of 0.02 μg/kg/day for total PCBs (ATSDR 2000). ATSDR has proposed draft health-based screening levels for four individual PFASs (PFOA: 0.003 μg/kg/day; PFNA 0.003 μg/kg/day; PFOS: 0.002 μg/kg/day; and PFHxS 0.02 μg/kg/day) (ATSDR 2018).

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McDougall, Robert

From: James Ehlers <[redacted]@gmail.com>
Sent: Thursday, February 13, 2020 9:32 AM
To: McDougall, Robert; Murphy, Laura
Cc: marguerite adelman
Subject: PFAS, thank you
Attachments: Fire fighting foam report from DOD at BTV.pdf

Robert and Laura,
Thank you for your time and, again, your service to our state.

Attached is the report we repeatedly referred to.

With gratitude,
James Ehlers

Final
Site Inspections Report
of Fire Fighting Foam Usage at
Vermont Air National Guard
Burlington Air National Guard Base
Chittenden County, Vermont

January 2018

Submitted to:
Air Force Civil Engineer Center
3515 General McMullen Suite 155
San Antonio, Texas 78226-2018

Submitted by:
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Savannah District
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Savannah, Georgia 31401-3640

Prepared by:
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under
Contract No. W912HN-15-C-0022

Final
Site Inspections Report
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Chittenden County, Vermont

January 2018

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Acronyms and Abbreviations

µg/L	micrograms per liter
µg/kg	microgram per kilogram
AFB	Air Force Base
AFCEC	Air Force Civil Engineer Center
AFFF	aqueous film forming foam
amsl	above mean sea level
ANG	Air National Guard
ASL	Aerostar SES LLC
bgs	below ground surface
BRLTN	Burlington Air National Guard Base
btoc	below top of casing
CAS	Chemical Abstracts Service
DOT	Department of Transportation
DPT	direct push technology
dup	duplicate
EPA	Environmental Protection Agency
ft.	foot or feet
FTA	fire training area
GAC	granular-activated carbon
gpm	gallons per minute
GPS	global positioning system
GW	groundwater
HA	health advisory
ID	identification
IDW	investigation-derived waste
IRP	Installation Restoration Program
J	The reported concentration is an estimated value.
LOQ	limit of quantification
mg/kg	milligrams per kilogram
MW	monitoring well
NA	not applicable
ND	not detected
NL	not listed
OWS	oil/ water separator
PA	preliminary assessment
PFAS	per- and polyfluorinated alkyl substances
PFBS	perfluorobutane sulfonate
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
pH	potential of hydrogen
QAPP	quality assurance project plan
RSL	regional screening level
SD	sediment
SI	site inspection
SM	silty sand
SO	subsurface soil
SP	poorly graded sand
SP-SM	poorly graded silty sand
SS	surface soil

SVOC	semivolatile organic compound
SW	surface water
TCLP	toxicity characteristic leaching procedure
TOC	total organic carbon
U	The analyte was not detected above the reporting value.
UJ	The analyte was not detected above the reported value. The reported value is approximate.
VDEC	Vermont Department of Environmental Conservation
VDH	Vermont Department of Health
VOC	volatile organic compound
VTANG	Vermont Air National Guard
USACE	United States Army Corps of Engineers
USAF	United States Air Force
USCS	Unified Soil Classification System
WWTP	wastewater treatment plant

1.0 INTRODUCTION

Aerostar SES LLC (ASL) under contract to the United States Army Corps of Engineers (USACE) Savannah District (Contract No. W912HN-15-C-0022) conducted screening-level site inspections (SIs) at five known or suspected aqueous film forming foam (AFFF) release areas at Burlington Air National Guard (ANG) Base (Figure 1, Appendix A). The purpose of the inspections was to determine the presence or absence of perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) in the environment at these areas. PFOA and PFOS are in a class of synthetic fluorinated chemicals used in industrial and consumer products, including defense-related applications. This class of compounds is also referred to as per- and polyfluorinated alkyl substances (PFAS).

In 1970, the United States Air Force (USAF) began using AFFF firefighting agents containing PFOS and PFOA to extinguish petroleum fires. Releases of AFFF to the environment routinely occur during fire training, equipment maintenance, storage, and use. Although manufacturers have reformulated AFFF to eliminate PFOS, the United States Environmental Protection Agency (EPA) continues to permit the use of PFOS-based AFFF, and the USAF maintains a significant inventory of PFOS-based AFFF. As of this report, the USAF is actively removing PFOS-based AFFF from its inventory and replacing it with formulations based on shorter carbon chains, which may be less persistent and bioaccumulative in the environment.

SIs were conducted at the Burlington ANG Base in April 2017 in accordance with contract requirements (USACE, February 2016), a quality assurance project plan (QAPP) (ASL, January 2016) and a site-specific addendum to the QAPP (ASL, February 2017). The QAPP and QAPP addendum were prepared in accordance with EPA guidance (EPA, March 2012) and Air Force Civil Engineer Center (AFCEC) requirements.

The objectives of the SIs were to

- determine if a confirmed release of PFOS, PFOA, or PFBS has occurred at the areas selected for inspection;
- determine if PFOS and PFOA are present in groundwater or surface water at the inspection areas at concentrations exceeding Vermont Groundwater Enforcement Standards;
- determine if PFBS is present in groundwater or surface water above generic EPA Regional Screening Levels (RSLs);
- determine if PFOA is present in soil or sediment at inspection areas above the Vermont Department of Health (VDH) screening level;
- determine if PFBS is present in soil or sediment at inspection areas above generic EPA RSLs;
- determine if PFOS is present in soil or sediment at the inspection areas at concentrations exceeding the calculated RSL; and
- identify potential receptor pathways with immediate impacts to human health (immediate impact to human health is considered consumption of drinking water with PFOS/PFOA above the Vermont Groundwater Enforcement Standard or PFBS above the RSL).

The Vermont Groundwater Enforcement Standard for combined PFOA and PFOS in groundwater is 0.02 µg/L (Vermont Department of Environmental Conservation [VDEC], December 2016). The EPA health advisory (HA) for drinking water for combined PFOA and PFOS is 0.07 µg/L. The VDH screening level for PFOA in surface soil is 300 µg/kg based on a residential use exposure scenario (Vose, March 2016). Screening levels for PFOA and PFOS in soil and sediment were calculated at 1,260 µg/kg using EPA's RSL calculator (https://epaprgs.ornl.gov/cgi-bin/chemicals/csl_search) (Appendix B). The toxicity value input for the calculator was the Tier 3 value reference dose of 0.00002 milligrams/kilograms per day derived by EPA in its drinking water health advisories for PFOS (EPA, May 2016a) and PFOA (EPA, May 2016b).

The VDH screening value for PFOA in surface soil was selected as the screening level for surface soil, subsurface soil and sediment because it is more conservative than the calculated RSL. Because the Vermont Groundwater Enforcement Standard for combined PFOA and PFOS is more conservative, 0.02 µg/L was selected as the screening level for groundwater and surface water.

In summary, a PFOS/PFOA release was considered confirmed when exceedances of the following concentrations were identified:

PFOS:

- 0.02 micrograms per liter (µg/L) in groundwater and surface water (combined with PFOA value).
- 1,260 micrograms per kilogram (µg/kg) in soil and sediment.

PFOA:

- 0.02 µg/L in groundwater and surface water (combined with PFOS value).
- 300 µg/kg in soil and sediment.

Although PFOS and PFOA are the focus of the HA and provide specific targets for the USAF to address in this SI, EPA has also derived RSLs for PFBS, for which there is a Tier 2 toxicity value (Provisional Peer Reviewed Toxicity Value). The USAF considered a release to be confirmed if exceedances of the following concentrations were identified:

PFBS:

- 400 µg/L in groundwater and surface water.
- 1,300,000 µg/kg in soil and sediment.

To better facilitate reporting and discussion of the investigation, sampling, and analysis of PFOA/ PFOS/ PFBS in this report, these compounds will hereafter be referred to collectively as PFAS. Table 1 presents the screening values for comparing the analytical results for each of the PFAS compounds.

This report does not include assessment of ecological exposure pathways, receptors, or risk from PFAS impacts to the environment. Confirmed releases may require further investigation to fully delineate the extent of contamination and perform a complete risk assessment that includes ecological receptors.

The five areas discussed in this report were identified in a preliminary assessment (PA) conducted in July 2015 (CH2M HILL, October 2015). The five areas (now identified as AFFF Areas 1 through 5) are listed in Table 2 and shown on Figure 2. A sixth area, a private plane crash on the runway, was also identified in the PA; however, at the direction of AFCEC, the site was not included in this effort because the aircraft was privately owned and the crash occurred off Base.

2.0 AREA DESCRIPTIONS

Burlington ANG Base is in western Chittenden County in South Burlington, Vermont, adjacent to the Burlington International Airport. The Base occupies approximately 240 acres of the 942-acre airport property and is 1.5 miles east of the Burlington city limits, 3.5 miles east of Lake Champlain, and approximately 0.25 miles southwest of the Winooski River. Burlington International Airport is to the south and west of the Base, residential neighborhoods are to the north, and agricultural farmland and the Winooski River are to the north and east. The Base supports the operation and maintenance of the 158th Fighter Wing and houses aircraft, support personnel, vehicles, and equipment. Vermont Air National Guard (VTANG) fire and rescue units support both military and civilian aircraft incidents.

Table 1 Regulatory Screening Values

Parameter	Chemical Abstracts Number	EPA Regional Screening Level Table (November 2017) [a]			Calculated Screening Level for Soils and Sediment[b] (µg/kg)	EPA Health Advisory for Drinking Water (Surface Water or Groundwater)[c] (µg/L)	Vermont Preliminary Soil Screening Values[d] (µg/kg)	Vermont Enforcement Standard for Groundwater (µg/L)[e]
		Residential Soil (µg/kg)	Industrial Soil (µg/kg)	Tap Water (µg/L)				
Perfluorobutane sulfonate (PFBS)	29420-43-3	1,300,000	16,000,000	400	N/A	NL	NL	NL
Perfluorooctanoic acid (PFOA)	335-67-1	NL	NL	NL	1,260	0.07[f]	300	0.02[g]
Perfluorooctane sulfonate (PFOS)	1763-23-1	NL	NL	NL	1,260		NL	

[a] EPA Regional Screening Levels (November 2017) (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017).
[b] Screening levels calculated using the EPA RSL calculator (https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search).
[c] EPA, May 2016a. "Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS)."
EPA, May 2016b. "Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA)."
[d] Vose, Sarah. Memorandum to Chuck Schwer, March 2016. *Perfluorooctanoic acid (PFOA) Soil Screening Value.*
[e] Vermont Department of Environmental Conservation, December 2016. Chapter 12 of the Environmental Protection Rules, "Groundwater Protection Rule and Strategy."
[f] The EPA Health Advisory value for drinking water of 0.07 µg/L applies to the combined detected concentrations of PFOS and PFOA.
[g] The Vermont Enforcement Standard for groundwater of 0.02 µg/L applies to the combined detected concentrations of PFOS and PFOA.

µg/kg = micrograms per kilogram
EPA = Environmental Protection Agency
NL = not listed
µg/L = micrograms per liter
N/A = not applicable

Table 2 Aqueous Film Form Foam Areas and Selection Rationale for Site Inspections at Burlington Air National Guard Base

AFFF Area	Location	Associated Existing IRP ID	Rationale	Media of Concern
1	Former FTA 1	Site 1	• Previous fire training area was not a closed system. • No known engineered containment. • AFFF likely used as extinguishing agent (volume unknown).	Subsurface soil Groundwater Sediment Surface water
2	Building 90 Former Fire Station	N/A	• Known previous storage of small quantities of AFFF. • AFFF refilling and truck washing activities may have resulted in releases. • No engineered containment. • Wash water was periodically pushed out the front bay doors with a squeegee.	Surface soil Subsurface soil Groundwater Sediment Surface water
3	Building 60 Current Fire Station	N/A	• AFFF refilling and truck washing activities may have resulted in releases. • Less than ½ gallon confirmed release of AFFF in one area.	Surface soil Subsurface soil Groundwater Sediment Surface water
4	Fire Department Equipment Testing Area	N/A	• Equipment containing AFFF was tested annually for several years. • An unknown volume of AFFF released. • No known engineered containment.	Surface soil Subsurface soil Groundwater
5	F-16 Emergency Response Site	N/A	• One-time response incident using AFFF from a hand line supplied from a fire truck. • No known containment or cleanup.	Surface soil Subsurface soil Groundwater

Table modified from Table 4.1 of *Final Preliminary Assessment Report for Perfluorinated Compounds at Vermont National Guard, South Burlington, Vermont* (CH2M HILL, October 2015)

AFFF = aqueous film forming foam
FTA = fire training area
ID = identification
ANG = Air National Guard
N/A = not applicable
IRP = Installation Restoration Program

The VTANG has operated continuously at Burlington airport since February 1951, when the 134th Fighter Squadron was assigned there. The air Base was activated as Ethan Allen Air Force Base (AFB) in February 1953 and operated on the north side of the airport. Ethan Allen AFB was closed as an active Base in May 1960 because of budget constraints, and the Base was transferred to the ANG and redesignated Burlington ANG Base. The VTANG 134th Fighter-Interceptor Squadron began operating out of the old airport administration building and the adjacent wooden hangar. The 134th Squadron was reorganized as the 158th Fighter Interceptor Group in mid-1960 and was placed under Air Defense Command. The Maintenance and Operations Squadrons immediately moved into the facilities vacated by the USAF with the closure of Ethan Allen AFB. The rest of the 158th Fighter Interceptor Group remained on the Williston Road side of the airfield, and military vehicles were allowed to cross the east end of the runway to transport personnel and materials after receiving clearance from the tower. The Base is now an industrial facility supporting the VTANG 158th Fighter Wing.

The climate at South Burlington, Vermont, consists of moderately warm summers and cold winters with average high temperatures ranging from 80.9 degrees Fahrenheit in July to 27 degrees Fahrenheit in January between 1980 and 2016. Annual precipitation averaged approximately 39 inches between 1980 and 2016, with precipitation between October and May typically falling as snow. Monthly precipitation ranged from an average low of 2.2 inches in February to average high of 4.3 inches in July. Mean annual snowfall, as measured from 1958 to 1987, was 78 inches (ASL, August 2017).

2.1 Former Fire Training Area 1 (Installation Restoration program Site 1) – AFFF Area 1

Former Fire Training Area (FTA) 1 is a grassed field east of NCO Drive on Burlington ANG Base (Figure 3, Appendix A). The field is bordered to the north by chain link fencing that serves as the northern perimeter of the Base and to the west by NCO Drive. A second FTA, FTA 2, is immediately south of FTA 1 and is included as part of FTA 1. Surface topography at FTA 1 slopes downward to the northeast, ranging from 309 to 311 feet above mean sea level (amsl) to approximately 277 feet amsl near Poor Farm Road. An intermittent stream to the southeast flows northeast toward Poor Farm Road. The area is used for recreational vehicle storage, Base equipment storage, and contractor material staging. Emergency response car extraction training is conducted south of FTA 1, and all other fire training activities are now conducted off-Base at the New Hampshire Fire Explorer Training Academy in Concord.

FTA 1 consisted of an approximately 150-foot-diameter primary burn area (FTA 1) and an approximately 50-foot-diameter secondary burn area (FTA 2) encompassing approximately 1/2 acre. Use of the FTAs began in 1960 and was discontinued in 1980. Training exercises were conducted an average of 26 times per year from 1960 to 1973 and an average of 12 times per year from 1973 to 1980. As much as 2,000 gallons of JP-4 were dispersed on the ground during each exercise between 1960 and 1973. From 1973 to 1980, dispersal was reduced to approximately 300 gallons during each exercise. Additionally, approximately 1,500 gallons of various mixtures of acetone, alcohol, cyclohexanone, methyl ethyl ketone, methanol, propyl alcohol, and waste paint pigments were collected from the surrounding communities and burned from 1979 to 1980 instead of JP-4. During periods of use, both FTAs were excavated to create shallow depressions to retain ignitable liquids. The liquids were ignited and the resultant fire would then be extinguished as part of the fire training exercise.

Installation Restoration Program (IRP) Site 1 was established in response to volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) that were released as part of fire training exercises. The uppermost 3 feet of fuel-contaminated soil was excavated from FTAs 1 and 2 in September 1980 and transported off site for disposal. The exact dimensions of the excavation are not known. Currently, IRP Site 1 includes a groundwater collection trench constructed in late 2003/early 2004 northeast of the site along National Guard Avenue and an active air sparging and soil vapor extraction system installed in 2012. Until recently, shallow groundwater intercepted by the groundwater collection trench was pumped to the Base sewer lift station and ultimately to the Airport Parkway Wastewater Treatment Plant (WWTP) in South Burlington, Vermont (CH2MHill, October 2015).

Unvalidated analytical results for a water sample collected by EPA from the groundwater collection trench sump on May 18, 2016, showed PFOS and PFOA concentrations of 38 µg/L and 9.3 µg/L respectively (H&S/Nobis Environmental JV, LLC, June 2016). As a result, the groundwater treatment system was modified to address PFOA and PFOS in groundwater at FTA 1. Since August 2017, groundwater from the collection trench has been treated for PFAS by routing it through two granular-activated carbon (GAC) vessels. Treated groundwater is pumped to infiltration trenches constructed at the site and is no longer pumped to the WWTP (CH2MHill, June 2017).

2.2 BUILDING 90 FORMER FIRE STATION – AFFF AREA 2

Building 50, the former fire station at Burlington ANG Base, was demolished in approximately 1995 prior to construction of Building 90, which now occupies the site. Building 90 is on the southwest side of NCO Drive and northeast of the F-16 flightline apron (Figure 4, Appendix A). The building is bordered to the northeast, northwest, and southwest by grassed lawn and to the southeast by a paved access/parking area.

Building 90 has never been used as a fire station and is currently used as an administrative building for deployments and for the STARBASE Vermont day camp for children. A review of historical topographic maps indicates that the original building (Building 50) was constructed between 1972 and 1983. According to historical imagery, Building 90 was constructed between May 2004 and October 2006.

The original fire station building did not have floor drains, and spills were pushed out the front of the three-bay doors facing the runway. A historical photograph suggests that the area in front of the three-bay doors was paved; however, the former bays are beneath the location of the current Building 90. Stormwater from the Building 90 area discharges to a drainage ditch approximately 960 feet to the east/northeast on the south side of Mustang Pass as shown on Figure 4 in Appendix A.

Because the fire station was active after 1970 (the year the USAF began using AFFF), historical use of AFFF at the fire station is considered likely. The VTANG fire department, however, has no knowledge or records of the quantity of AFFF that may have been used/released during AFFF transfer and filling operations at the former fire station (ASL, August 2017).

2.3 BUILDING 60 CURRENT FIRE STATION – AFFF AREA 3

Building 60, the current Base fire station, is north of the airfield between Taxiway F and NCO Drive (Figure 5, Appendix A). The fire station is bordered to the northwest and southeast by grassed lawn and to the northeast and southwest by paved access ramps.

Fire engine bays are in the northwest end of the building, and office space is in the southeast end of the building. Fire trucks are washed within the bays at Building 60. The building has a floor drain system that transports liquids to an oil/ water separator (OWS) system on the north side of the building. OWS fluid goes to the Base wastewater lift station, where it is pumped under the runway to the South Burlington Airport Parkway WWTP. Stormwater from the Building 60 area discharges across NCO Drive to an intermittent stream approximately 300 feet to the northeast.

The only reported release of AFFF at the building occurred on July 22, 2015, when approximately ½ gallon of AFFF was released while transferring 130 gallons of AFFF from a P-19 vehicle to the foam storage trailer. The AFFF was rinsed into the grass area adjacent to the concrete pad on the northwest side of Building 60. No other releases of AFFF have been reported at Building 60 (ASL, August 2017).

2.4 FIRE DEPARTMENT EQUIPMENT TESTING AREA – AFFF AREA 4

Until July 2015, the VTANG fire department tested fire equipment annually using AFFF along an approximately 700-foot section of Taxiway F as shown on Figure 6 (Appendix A). Foam was typically sprayed directly onto grassed areas on either side of the 50-foot wide taxiway, but occasionally it was sprayed on the taxiway and washed to the grassed areas. The discharge range of the equipment is approximately 225 feet. During the June 2015 test, approximately 65 gallons of AFFF solution (water and AFFF) were released to Taxiway F and washed to grassed areas on either side of the taxiway. On July 30, 2015, the Base received notification from AFCEC to discontinue testing equipment with AFFF because of environmental concerns.

2.5 F-16 EMERGENCY RESPONSE SITE – AFFF AREA 5

A 1995/1996 F-16 bird strike required using a cable arresting system at the north end of the runway to stop the F-16 during landing. An equipment malfunction caused a fire at the tail of the jet, and AFFF from a fire truck hand line was used to extinguish the flames. The AFFF/water solution (volume unknown) was likely washed off the runway to the grassed areas on either side of the runway. The approximate location of the incident was the centerline of the runway just north of the arresting system and North Barrier Road and is outside the current Base boundary as shown on Figures 2 and 7 in Appendix A.

3.0 FIELD ACTIVITIES AND FINDINGS

ASL conducted field activities at Burlington ANG Base the week of April 17, 2017. Fieldwork was conducted in accordance with the QAPP (ASL, January 2016) and the Base-specific field sampling plan addendum to the QAPP (ASL, February 2017). A readiness review covering anticipated hazards, types and proper use of equipment needed for field activities, sampling procedures, and procedures to prevent cross-contamination of samples with PFAS-containing compounds was conducted with all ASL field personnel prior to mobilization. Documentation of this review is in Appendix C.

Field activities included collecting groundwater samples (from direct push technology [DPT] borings, temporary wells, and existing monitoring wells), collecting surface soil and subsurface soil samples (from hand auger and DPT soil borings), and collecting surface water and sediment samples. ASL selected sampling locations in areas most likely to have been impacted by known or suspected AFFF releases. Field duplicate samples were collected at a frequency of one for every 10 samples for each sample media. Matrix spike/matrix spike duplicate samples were collected at a frequency of one for every 20 samples for each media. Boring logs and sample collection forms are in Appendix C.

Soil, sediment, groundwater, and surface water samples were submitted via overnight courier to Maxxam Analytics International Corporation of Mississauga, Ontario, Canada, under chain of custody procedures and analyzed for PFAS using modified EPA Method 537. All samples were analyzed for the following parameters.

Analyte	*CAS Number
Perfluorobutane sulfonate (PFBS)	29420-43-3
Perfluorooctanoic acid (PFOA)	335-67-1
Perfluorooctane sulfonate (PFOS)	1763-23-1

*CAS = Chemical Abstracts Service

Third-party data validation was conducted on 100% of the analytical data. Overall, the quality of the data was acceptable. The precision and accuracy results were acceptable for the project. Other data quality indicators (representativeness, comparability, and completeness) also met the project objectives. All the results were evaluated as usable for the decisions being made. With the exception of AFFF Area 5 (discussed in Section 3.5.4), determinations of an AFFF release were not based on quality-control-qualified data. The data validation report, laboratory case narratives, and laboratory analytical data sheets are presented in Appendix D.

To provide basic soil parameter information, ASL also collected representative composite surface soil and subsurface soil samples for physiochemical parameters from each area. The composite samples were submitted to CT Laboratories LLC of Baraboo, Wisconsin, and analyzed for potential of hydrogen (pH), particle size distribution, total organic carbon (TOC), and percent solids; the results of these analyses are in Appendix F.

Soil borings were advanced with a track-mounted DPT drill rig. Surface soil samples were collected to a depth of 6 inches below ground surface (bgs) with stainless steel hand augers. Subsurface soil samples were collected immediately above the water saturated/unsaturated soil interface using a DPT Macro-core® sampler with acetate liner. Soil samples were placed in containers using stainless steel spoons.

Groundwater samples collected from existing and temporary monitoring wells were collected with peristaltic pumps and disposable polyvinyl tubing inserted to the approximate midpoint of the saturated portion of the screened interval. Groundwater samples were collected from DPT soil borings using a reusable GeoProbe® SP16 drive point groundwater sampler consisting of a sheathed 0.78-inch inside diameter by 41-inch-long stainless steel screen. The drive point was advanced to the desired depth and the sheath retracted, exposing the screen. Groundwater samples were then collected with peristaltic pumps and polyvinyl tubing inserted through the drill rods into the screen.

Sediment samples were collected using stainless steel spoons. Surface water samples were collected by attaching the sample container to an extendable rod designed for sampling and dipping the container into the water.

Coordinates and elevations for soil borings and temporary wells at AFFF Areas 1, 2, and 3 were established by Button Professional Land Surveyors, PC of South Burlington, Vermont. Northing and easting coordinates were recorded in the Vermont State Plane Coordinate System based on North American Datum 1983. Elevations were referenced to North American Vertical Datum 1988. Soil borings at AFFF Areas 4 and 5 were recorded with a Trimble GeoX7 handheld global positioning system (GPS) unit. All sediment and surface water sample points were recorded with a Trimble GeoX7 GPS unit.

Sample locations, area-specific lithology, groundwater flow direction, analytical results, and conclusions for each AFFF area are presented in Sections 3.1 through 3.5.

3.1 Former Fire Training Area 1 (Installation Restoration Program Site 1) – AFFF Area 1

3.1.1 Sample Locations

To assess possible PFAS impacts from previous use of AFFF at FTA 1 (including FTA 2), three subsurface soil samples (two primary and one duplicate), nine groundwater samples (eight primary and one duplicate), two sediment samples (one primary and one duplicate), and two surface water samples (one primary and one duplicate) were collected. Subsurface soil and drive point groundwater samples were collected from soil borings BRLTN01-001 and BRLTN01-002 at FTA 1 and FTA 2.

Groundwater samples were collected from existing monitoring wells V1-BP2 and V1-BP3 at FTA 1 (source area) and from existing downgradient wells MW-102, MW-103, and V1-MW-14L. Downgradient monitoring wells MW-103 and V1-MW-14L were sampled to assess possible PFAS impacts within known organic solvent plumes identified during the remedial investigation of FTA 1, which may represent preferred pathways (Parsons, June 2002). Downgradient well MW-102 was sampled to evaluate possible PFAS impacts along a more easterly flow pathway toward the Winooski River. V1-MW-14L was sampled in lieu of planned well MW-104, which could not be sampled because of a blockage in the well. A sample was also collected from the groundwater collection trench sump (BRLTN01-TRENCHSUMP) near Poor Farm Road to verify the May 2016 EPA sampling results.

Sediment and surface water samples were collected at BRLTN01-003 from an intermittent stream immediately south of the groundwater collection trench sump and downstream from the FTAs. Sample locations are shown on Figure 3 in Appendix A. Surface soil was not sampled because hydrocarbon/ solvent-impacted soil had been excavated from the area during a previous remediation effort.

3.1.2 Lithology

The two soil borings completed at the former FTA were terminated at 15 feet bgs. Soils encountered at these borings included silty sand (Unified Soil Classification System [USCS] – SM), well-graded sand (USCS – SW), poorly graded sand (USCS – SP), and silt (USCS – ML). Detailed boring logs are included in Appendix C.

3.1.3 Groundwater Flow

On April 21, 2017, groundwater level measurements were collected from eight existing monitoring wells at FTA 1. Total depths of these wells range from 11 feet to 27 feet bgs, and groundwater was detected at depths ranging from 3.07 feet to 18.95 feet below top of casing (btoc). Groundwater at FTA 1 flows to the northeast toward the groundwater collection trench as shown on Figure 3 in Appendix A. Downgradient of the collection trench, groundwater flows to the east/northeast toward the Winooski River. Groundwater level measurements and elevations on April 21, 2017, are summarized in Table G-1 in Appendix G.

3.1.4 Analytical Results

Subsurface Soil
Two primary subsurface soil samples and one duplicate sample were collected from soil borings BRLTN01-001 and BRLTN01-002 at FTA 1. PFBS was not detected in any of the samples, but PFOA and PFOS were detected in all three samples. PFOA was detected at concentrations ranging from an estimated 0.38 µg/kg to 25 µg/kg, and PFOS was detected at concentrations ranging from an estimated 4.7 µg/kg to an estimated 1,200 µg/kg, all below their respective screening levels. Results are summarized in Table 3 and shown on Figure 8 in Appendix A.

Soil Physiochemical Analyses
To provide basic soil parameter information, composite surface soil and subsurface soil samples were collected from FTA 1 soil borings and submitted for pH, TOC, and grainsize analysis. The surface soil sample (BRLTN01-004-SS-001) was composed of equal aliquots of soil collected from borings BRLTN01-001 and BRLTN01-002 at 6 inches bgs. The subsurface soil sample (BRLTN01-004-SO-008) was composed of equal aliquots of soil collected from the same borings at depths of 8 and 7feet respectively. Table F-1 summarizing the physiochemical data and supporting laboratory data sheets are included in Appendix F.

Table 3 Former Fire Training Area 1 (AFFF Area 1) Subsurface Soil Analytical Results

	Sample ID	BRLTN01-001-SO-008	BRLTN01-002-SO-007	BRLTN01-002-SO-907 (dup)
	Date Collected	04/20/17	04/19/17	04/19/17
	Depth (ft. bgs)	7 – 8	6 - 7	6 - 7
Analyte	**Screening Level (µg/kg)**	**Result (µg/kg)**	**Result (µg/kg)**	**Result (µg/kg)**
Perfluorobutane sulfonate (PFBS)	1,300,000[a]	0.66 UJ	5.1 U	6.2 U
Perfluorooctanoic acid (PFOA)	300[b]	**0.38 J**	**18**	**25**
Perfluorooctane sulfonate (PFOS)	1,260[c]	**4.7 J**	**590 J**	**1,200 J**

Bold values indicate analyte detected at concentration indicated.
[a]EPA Regional Screening Levels (RSLs) for Residential Soil (November 2017) (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017)
[b] Vose, Sarah. Memorandum to Chuck Schwer, March 2016. *Perfluorooctanoic acid (PFOA) Soil Screening Value.*
[c]Screening level calculated using the EPA RSL calculator (https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search).
µg/kg = micrograms/kilogram
BRLTN = Burlington Air National Guard Base
ft. = foot or feet
SO = subsurface soil
bgs = below ground surface
dup = field duplicate
J = reported concentration is an estimated value
U = analyte was not detected above the reported value

Groundwater

Eight primary groundwater samples and one duplicate sample were collected at AFFF Area 1. Groundwater samples were collected from two soil borings (BRLTN01-001 and BRLTN01-002), five existing monitoring wells (two source area wells and three downgradient wells), and from the downgradient groundwater collection trench sump.

PFBS was detected in seven of eight groundwater samples (six primary samples and one duplicate sample) and in the trench sump sample at concentrations ranging from 0.52 µg/L to 3.4 µg/L, all below the RSL of 400 µg/L. PFOA and PFOS were also detected in each of the groundwater samples and in the trench sump sample at combined concentrations ranging from 4.75 µg/L to 72 µg/L all above the 0.02 µg/L screening level. Groundwater analytical results for PFBS, PFOA, and PFOS are presented in Table 4 and are shown on Figure 9 in Appendix A.

Sediment

One primary and one duplicate sediment sample were collected from an intermittent stream downstream from FTA 1 at BRLTN01-003. PFBS was detected at concentrations of 1.2 µg/kg and 1.3 µg/kg; PFOA was detected at concentrations of 2.2 µg/kg and 2.0 µg/kg; and PFOS was detected at concentrations of 170 µg/kg and 180 µg/kg. All PFBS, PFOA, and PFOS detections were below their respective screening levels as summarized in Table 5 and shown on Figure 8 in Appendix A.

Table 4 Former Fire Training Area 1 (AFFF Area 1) Groundwater Analytical Results

	Sample ID	BRLTN01-001-GW-013	BRLTN01-002-GW-015	BRLTN01-TRENCHSUMP-001	BRLTN01-MW-V1BP2-009	BRLTN01-MW-BP3-012
	Date Collected	04/20/17	04/19/17	04/19/17	04/20/17	04/20/17
	Depth (ft. bgs)	13	15	9	9	12
Analyte	Screening Level (µg/L)	Result (µg/L)	Result (µg/L)	Result (µg/L)	Result (µg/L)	Result (µg/L)
Perfluorobutane sulfonate (PFBS)	400[a]	**1.1**	**0.52**	**0.87**	0.10 U	**3.4**
Perfluorooctanoic acid (PFOA)	0.02[b]	**0.47**	**2.7**	**4.2**	**1.3**	**41**
Perfluorooctane sulfonate (PFOS)	0.02[b]	**8.8**	**3.0**	**15**	**16**	**31**
PFOS +PFOA	0.02[b]	**9.27**	**5.7**	**19.2**	**17.3**	**72**

	Sample ID	BRLTN01-MW102-011	BRLTN01-MW103-009	BRLTN01-MW103-909 (dup)	BRLTN01-V1MW14L-008
	Date Collected	04/18/17	04/18/17	04/18/17	04/19/17
	Depth (ft. bgs)	11	9	9	8
Analyte	Screening Level (µg/L)	Result (µg/L)	Result (µg/L)	Result (µg/L)	Result (µg/L)
Perfluorobutane sulfonate (PFBS)	400[a]	**1.4**	**1.7**	**1.7**	**1.7 J**
Perfluorooctanoic acid (PFOA)	0.02[b]	**0.55**	**1.4**	**1.4**	**1.8**
Perfluorooctane sulfonate (PFOS)	0.02[b]	**4.2**	**18**	**20**	**7.6**
PFOS +PFOA	0.02[b]	**4.75**	**19.4**	**21.4**	**9.4**

Bold values indicate analyte detected at concentration indicated. Shaded values indicate analyte exceeds screening criteria.

[a]EPA Regional Screening Levels for Residential Soil (November 2017))https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017)

[b]Vermont Department of Environmental Conservation, December 2016. Chapter 12 of the Environmental Protection Rules, "Groundwater Protection Rule and Strategy."

µg/L = micrograms per liter
BRLTN = Burlington Air National Guard Base
ft = foot or feet
GW = groundwater
J = reported concentration is an estimated value
U = analyte was not detected above the reported value
bgs = below ground surface
dup = duplicate
FTA = fire training area
ID = identification
MW = monitoring well

Table 5 Former Fire Training Area 1 (AFFF Area 1) Sediment Analytical Results

	Sample ID	BRLTN01-003-SD-001	BRLTN01-003-SD-901 (dup)
	Date Collected	04/18/17	04/18/17
	Depth (ft. bgs)	0 - 0.5	0 - 0.5
Analyte	**Screening Level (µg/kg)**	**Result (µg/kg)**	**Result (µg/kg)**
Perfluorobutane sulfonate (PFBS)	1,300,000[a]	**1.2**	**1.3**
Perfluorooctanoic acid (PFOA)	300[b]	**2.2**	**2.0**
Perfluorooctane sulfonate (PFOS)	1,260[c]	**170**	**180**

Bold values indicate analyte detected at concentration indicated.
[a]EPA Regional Screening Levels for Residential Soil (November 2017) (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017)
[b] Vose, Sarah. Memorandum to Chuck Schwer, March 2016. *Perfluorooctanoic acid (PFOA) Soil Screening Value.*
[c]Screening level calculated using the EPA RSL calculator (https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search).
µg/kg = micrograms per kilograms
BRLTN = Burlington Air National Guard Base
ft. = foot or feet
ID = identification
bgs = below ground surface
dup = field duplicate
FTA = fire training area
SD = sediment

Surface Water

One primary and one duplicate surface water sample were also collected from the intermittent stream downstream from FTA 1 at BRLTN01-003. PFBS was detected in both samples at concentrations of 2.0 µg/L and 1.9 µg/L, below the 400 µg/L screening level. PFOA and PFOS were detected in both samples at combined concentrations of 35.3 µg/L and 38.4 µg/L, above the 0.02 µg/L screening level as summarized in Table 6 and shown on Figure 9 in Appendix A.

Table 6 Former Fire Training Area 1 (AFFF Area 1) Surface Water Analytical Results

	Sample ID	BRLTN01-003-SW-001	BRLTN01-003-SW-901 (dup)
	Date Collected	04/18/17	04/18/17
Analyte	**Screening Level (µg/L)**	**Result (µg/L)**	**Result (µg/L)**
Perfluorobutane sulfonate (PFBS)	400[a]	**2.0**	**1.9**
Perfluorooctanoic acid (PFOA)	0.02[b]	**1.3**	**1.4**
Perfluorooctane sulfonate (PFOS)	0.02[b]	**34**	**37**
PFOS +PFOA	0.02[b]	**35.3**	**38.4**

Bold values indicate analyte detected at concentration indicated.
Shaded values indicate analyte exceeds screening criteria.
[a]EPA Regional Screening Levels for Residential Soil (November 2017) (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017)
[b]Vermont Department of Environmental Conservation, December 2016. Chapter 12 of the Environmental Protection Rules, "Groundwater Protection Rule and Strategy."
µg/L = micrograms per liter
dup = field duplicate
SW = surface water
BRLTN = Burlington Air National Guard Base
ID = identification

3.1.5 Conclusions

Use of AFFF during training exercises at FTA 1 has resulted in releases of PFAS to the environment. Although PFOA and PFOS concentrations in soil and sediment were below screening levels, combined PFOA and PFOS concentrations exceeded the screening level in groundwater and surface water. Combined PFOA and PFOS concentrations were above screening levels in seven primary and one duplicate groundwater sample, one primary and one duplicate surface water sample, and a groundwater collection trench sump sample. The maximum combined PFOA and PFOS concentration detected was 72 µg/L in groundwater and 38.4 µg/L in surface water. PFBS was not detected above screening levels in any media sampled at AFFF Area 1.

3.2 Building 90 Former Fire Station – AFFF Area 2

3.2.1 Sample Locations

To assess possible PFAS impacts from AFFF that may have been used/released during AFFF transfer and filling operations at the former fire station, four surface soil samples (three primary and one duplicate), three subsurface soil samples, three groundwater samples, one sediment sample, and one surface water sample were collected. Surface soil and subsurface soil samples were collected from soil borings BRLTN02-001, BRLTN02-002, and BRLTN02-003 around the original fire station footprint. Groundwater samples were collected from temporary monitoring wells installed in each of the soil borings. Sediment and surface water samples were collected at BRLTN02-004 at a downstream stormwater discharge at a drainage ditch approximately 960 feet east/northeast of Building 90 on the south side of Mustang Pass. It is noted that after completion of the SI sampling effort (during review of the draft SI report), the Base provided information indicating that 730 tons of soil were removed from the drainage swale in 2012 as part of a remedial action for IRP Site 4 (Drainage Ditch Area). Soil was excavated to a depth of 2 feet and backfilled. The location of sediment and surface water sample BRLTN02-004 is within the limits of the remedial action area (CH2MHill, June 2012). Sample locations are shown on Figure 4 in Appendix A.

3.2.2 Lithology

The three soil borings completed at AFFF Area 2 were terminated at depths ranging from 30 to 35 feet bgs. Soils encountered at these borings included silty sand (USCS – SM) and well-graded sand (USCS – SW), and poorly graded sand (USCS – SP). Detailed boring logs are included in Appendix C.

3.2.3 Groundwater Flow

On April 21, 2017, groundwater level measurements were collected from the three temporary monitoring wells at the former fire station (BRLTN02-001, BRLTN02-002, and BRLTN02-003). Total depth of these wells ranged from 30 feet to 35 feet bgs, and groundwater was detected at depths ranging from 25.05 feet to 29.29 feet btoc. Based on the April 21, 2017, water level measurements and water levels collected from adjacent AFFF Area 3, groundwater flows to the east/northeast as shown on Figure 4 in Appendix A. Water level measurements and groundwater elevations are summarized in Table G-1 in Appendix G.

3.2.4 Analytical Results

Surface Soil
Three primary surface soil samples and one duplicate sample were collected from soil borings BRLTN02-001, BRLTN02-002, and BRLTN02-003 at Building 90, site of the former fire station. PFBS was detected in the duplicate sample collected at BRLTN02-001 at an estimated concentration of 0.28 µg/kg but was not detected in any of the three primary samples. PFOA and PFOS were detected in all four samples. PFOA was detected at estimated concentrations ranging from 0.53 µg/kg to 0.91 µg/kg and PFOS was detected at estimated concentrations ranging from 5.6 µg/kg to 31 µg/kg. PFOA and PFOS

detections were all below their respective screening levels, as summarized in Table 7 and shown on Figure 10 in Appendix A.

Table 7 Building 90 Former Fire Station Location (AFFF Area 2) Surface Soil Analytical Results

	Sample ID	BRLTN02-001-SS-001	BRLTN02-001-SS-901 (dup)	BRLTN02-002-SS-001	BRLTN02-003-SS-001
	Date Collected	04/18/17	04/18/17	04/18/17	04/18/17
	Depth (ft. bgs)	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5
Analyte	Screening Level (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)
Perfluorobutane sulfonate (PFBS)	1,300,000[a]	0.50 UJ	**0.28 J**	0.66 U	0.66 UJ
Perfluorooctanoic acid (PFOA)	300[b]	**0.53 J**	**0.69 J**	**0.91 J**	**0.70 J**
Perfluorooctane sulfonate (PFOS)	1,260[c]	**31 J**	**28**	**21**	**5.6 J**

Bold values indicate analyte detected at concentration indicated.
[a]EPA Regional Screening Levels (RSLs) for Residential Soil (November 2017) [https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017]
[b]Vose, Sarah. Memorandum to Chuck Schwer, March 2016. *Perfluorooctanoic acid (PFOA) Soil Screening Value.*
[c]Screening level calculated using the EPA RSL calculator (https://epa-prgs.ornl.gov/cgi-bin/chemicals/cls_search)
µg/kg = micrograms per kilogram; bgs = below ground surface; BRLTN = Burlington Air National Guard
dup = duplicate; ID = identification; J = reported concentration is an estimated value
SS = surface soil; U = analyte was not detected above the reported value

Subsurface Soil

Three subsurface soil samples were also collected from soil borings BRLTN02-001, BRLTN02-002, and BRLTN02-003 at Building 90. PFBS was not detected in any of the samples. PFOA and PFOS, however, were detected in all three samples. PFOA was detected at estimated concentrations ranging from 0.52 µg/kg to 7.8 µg/kg, and PFOS was detected at concentrations ranging from an estimated 20 µg/kg to 160 µg/kg. PFOA and PFOS detections were all below their respective screening levels, as summarized in Table 8 and shown on Figure 10 in Appendix A.

Table 8 Building 90 Former Fire Station Location (AFFF Area 2) Subsurface Soil Analytical Results

	Sample ID	BRLTN02-001-SO-020	BRLTN02-002-SO-020	BRLTN02-003-SO-025
	Date Collected	04/18/17	04/18/17	04/18/17
	Depth (ft. bgs)	19 - 20	19 - 20	24 - 25
Analyte	Screening Level (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)
Perfluorobutane sulfonate (PFBS)	1,300,000[a]	0.58 U	0.66 U	0.52 UJ
Perfluorooctanoic acid (PFOA)	300[b]	**1.7**	**0.52 J**	**7.8 J**
Perfluorooctane sulfonate (PFOS)	1,260[c]	**160**	**160**	**20 J**

Bold values indicate analyte detected at concentration indicated.
[a]EPA Regional Screening Levels (RSLs) for Residential Soil (November 2017) (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017)
[b]Vose, Sarah. Memorandum to Chuck Schwer, Director of Waste Management, Vermont Department of Environmental Conservation, March 2016. *Perfluorooctanoic acid (PFOA) Soil Screening Value.*
[c]Screening level calculated using the EPA RSL calculator (https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search).
µg/kg = micrograms per kilogram; bgs = below ground surface; BRLTN = Burlington Air National Guard Base
ft. = foot or feet; ID = identification; J = reported concentration is an estimated value
SO = subsurface soil; U = analyte was not detected above the reported value

Soil Physiochemical Analyses

To provide basic soil parameter information, composite surface soil and subsurface soil samples were collected from Building 90 soil borings and submitted for pH, TOC, and grainsize analysis. The surface soil sample (BRLTN02-005-SS-001) was composed of equal aliquots of soil collected from borings BRLTN02-001, BRLTN02-002, and BRLTN02-003 at 6 inches bgs. The subsurface soil sample (BRLTN02-005-SO-032) was composed of equal aliquots of soil collected from the same borings at 20 feet bgs, 20 feet bgs, and 25 feet bgs, respectively. Table F-1 summarizing the physiochemical data and supporting laboratory data sheets are included in Appendix F.

Groundwater

Three groundwater samples were collected from the three temporary wells at Building 90. PFBS was detected in all three samples at concentrations ranging from 0.14 µg/L to 0.47 µg/L, below the 400 µg/L screening level. PFOA and PFOS were also detected in all three samples at combined concentrations ranging from 9.48 µg/L to 54.5 µg/L, all above the 0.02 µg/L screening level. PFBS, PFOA, and PFOS groundwater analytical results are summarized in Table 9 and shown on Figure 11 in Appendix A.

Table 9 Building 90 Former Fire Station Location (AFFF Area 2) Groundwater Analytical Results

	Sample ID	BRLTN02-001-GW-027	BRLTN02-002-GW-029	BRLTN02-003-GW-032
	Date Collected	04/20/17	04/21/17	04/21/17
	Depth (ft. btoc)	27	29	32
Analyte	**Screening Level (µg/L)**	**Result (µg/L)**	**Result (µg/L)**	**Result (µg/L)**
Perfluorobutane sulfonate (PFBS)	400[a]	**0.25 J**	**0.47**	**0.14**
Perfluorooctanoic acid (PFOA)	0.02[b]	**0.23**	**0.50**	**0.28**
Perfluorooctane sulfonate (PFOS)	0.02[b]	**14**	**54**	**9.2**
PFOS +PFOA	0.02[b]	**14.23**	**54.5**	**9.48**

Bold values indicate analyte detected at concentration indicated.
Shaded values indicate analyte exceeds screening criteria.
[a]EPA Regional Screening Levels for Residential Soil (November 2017) (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017)
[b]Vermont Department of Environmental Conservation, December 2016. Chapter 12 of the Environmental Protection Rules, "Groundwater Protection Rule and Strategy."
µg/L = micrograms per liter
btoc = below top of casing
GW = groundwater
J = reported concentration is an estimated value
BRLTN = Burlington Air National Guard Base
ft. = foot or feet
ID = identification

Sediment

One sediment sample was collected from a drainage ditch approximately 960 feet east/northeast of Building 90 at BRLTN02-004. PFOS was detected in the sample at a concentration of 2.3 µg/kg, below the 1,260 µg/kg screening level. PFBS and PFOA were not detected. Analytical results are summarized in Table 10 and shown on Figure 10 in Appendix A.

Surface Water

One surface water sample was also collected from the drainage ditch east/northeast of Building 90 at BRLTN02-004. PFBS was detected at a concentration of 0.035 µg/L, below the 400 µg/L screening level. PFOS was detected at a concentration of 0.081 µg/L, above the 0.02 µg/L screening level; PFOA was not detected. Analytical results are summarized in Table 11 and shown on Figure 11 in Appendix A.

Table 10 Building 90 Former Fire Station Location (AFFF Area 2) Sediment Analytical Results

	Sample ID	BRLTN02-004-SD-001
	Date Collected	04/18/17
	Depth (ft. bgs)	0 - 0.5
Analyte	Screening Level (µg/kg)	Result (µg/kg)
Perfluorobutane sulfonate (PFBS)	1,300,000[a]	0.72 U
Perfluorooctanoic acid (PFOA)	300[b]	0.72 U
Perfluorooctane sulfonate (PFOS)	1,260[c]	**2.3**

Bold values indicate analyte detected at concentration indicated.
[a]EPA Regional Screening Levels (RSLs) for Residential Soil (November 2017) (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017).
[b]Vose, Sarah. Memorandum to Chuck Schwer, March 2016. *Perfluorooctanoic acid (PFOA) Soil Screening Value.*
[c]Screening level calculated using the EPA RSL calculator (https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search).
µg/kg = micrograms per kilogram
BRLTN = Burlington Air National Guard Base
ID = identification
U = analyte was not detected above the reported value
bgs = feet below ground surface
ft. = foot or feet
SD = sediment

Table 11 Building 90 Former Fire Station Location (AFFF Area 2) Surface Water Analytical Results

	Sample ID	BRLTN02-004-SW-001
	Date Collected	04/18/17
Analyte	Screening Level (µg/L)	Result (µg/L)
Perfluorobutane sulfonate (PFBS)	400[a]	**0.035**
Perfluorooctanoic acid (PFOA)	0.02[b]	0.010 U
Perfluorooctane sulfonate (PFOS)	0.02[b]	**0.081**
PFOS +PFOA	0.02[b]	**0.081**

Bold values indicate analyte detected at concentration indicated.
Shaded values indicate analyte exceeds screening criteria.
[a]EPA Regional Screening Levels for Residential Soil (November 2017) [https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017]
[b]Vermont Department of Environmental Conservation, December 2016. Chapter 12 of the Environmental Protection Rules, "Groundwater Protection Rule and Strategy."
µg/L = micrograms per liter
ID = identification
U = analyte was not detected above the reported value
BRLTN = Burlington Air National Guard
SW = surface water

3.2.5 Conclusions

Apparent AFFF spills at the former fire station have resulted in releases of PFAS to the environment. Combined PFOA and PFOS concentrations were above screening levels in each of the three groundwater samples and in the one surface water sample collected. The maximum combined PFOA and PFOS concentration was 54.5 µg/L in groundwater and 0.081 µg/L in surface water. PFOA and PFOS concentrations in soil and sediment were below screening levels, and PFBS was not detected above screening levels in any sampled media at AFFF Area 2. The location of sediment and surface water sample BRLTN02-004 is within the limits of the IRP Site 4 (Drainage Ditch Area) remedial action area, and the sediment sample represents backfill and sediment deposition since 2012.

3.3 BUILDING 60 CURRENT FIRE STATION – AFFF AREA 3

3.3.1 Sample Locations

To assess possible PFAS impacts from the release of approximately 1/2 gallon of AFFF at the fire station, two surface soil samples, two subsurface soil samples, two groundwater samples, one sediment sample, and one surface water sample were collected. Surface soil and subsurface soil samples were collected from soil borings BRLTN03-001 and BRLTN03-002 on the north side of Building 60 in the grassed area, where the spilled AFFF was rinsed. Groundwater samples were collected from temporary wells installed at each soil boring. Sediment and surface water samples were collected at BRLTN03-003, where storm water from the fire station discharges to a drainage ditch approximately 300 feet to the northeast across NCO Drive. Sample locations are shown on Figure 5 in Appendix A.

3.3.2 Lithology

The two soil borings completed at AFFF Area 3 were terminated at a depth of 25 feet bgs. Soils encountered included silty sand (USCS – SM) well-graded sand (USCS – SW), poorly graded sand (USCS – SP), and sandy silt (USCS – ML). Detailed boring logs are included in Appendix C.

3.3.3 Groundwater Flow

On April 21, 2017, groundwater level measurements were collected from the two temporary monitoring wells at the current fire station (BRLTN03-001 and BRLTN03-002). Total depth of each well was 25 feet bgs, and groundwater was detected at 18.87 feet and 18.35 feet btoc, respectively. Based on these water level measurements (and water levels collected from adjacent AFFF Area 2), groundwater flows to the east/ northeast as shown on Figure 5 in Appendix A. Water level measurements and groundwater elevations are summarized in Table G-1 in Appendix G.

3.3.4 Analytical Results

Surface Soil
Two surface soil samples were collected from soil borings BRLTN03-001 and BRLTN03-002 at Building 60. PFBS was detected in both samples at estimated concentrations of 0.32 µg/kg and 0.71 µg/kg. PFOA was detected at estimated concentrations of 1.5 µg/kg and 0.92 µg/kg, and PFOS was detected at concentrations of 280 µg/kg and 170 µg/kg. All PFBS, PFOA, and PFOS detections were below their respective screening levels, as summarized in Table 12 and shown on Figure 12 in Appendix A.

Subsurface Soil
Two subsurface soil samples were also collected from soil borings BRLTN03-001 and BRLTN03-002 at Building 60. PFBS was in both samples at estimated concentrations of 0.37 µg/kg and 0.49 µg/kg. PFOA was detected at concentrations of 1.0 µg/kg and an estimated 0.54 µg/kg, and PFOS was detected at concentrations of 140 µg/kg and 110 µg/kg. All PFBS, PFOA, and PFOS detections were below their respective screening levels, as summarized in Table 13 and shown on Figure 12 in Appendix A.

Table 12 Building 60 Current Fire Station (AFFF Area 3) Surface Soil Analytical Results

	Sample ID	BRLTN03-001-SS-001	BRLTN03-002-SS-001
	Date Collected	04/18/17	04/18/17
	Depth (ft. bgs)	0 - 0.5	0 - 0.5
Analyte	Screening Level (µg/kg)	Result (µg/kg)	Result (µg/kg)
Perfluorobutane sulfonate (PFBS)	1,300,000[a]	**0.32 J**	**0.71 J**
Perfluorooctanoic acid (PFOA)	300[b]	**1.5 J**	**0.92 J**
Perfluorooctane sulfonate (PFOS)	1,260[c]	**280**	**170**

Bold values indicate analyte detected at concentration indicated.
[a]EPA Regional Screening Levels (RSLs) for Residential Soil (November 2017) [https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017]
[b]Vose, Sarah, State Toxicologist, Vermont Department of Health. Memorandum to Chuck Schwer, Director of Waste Management, Vermont Department of Environmental Conservation, March 2016. *Perfluorooctanoic acid (PFOA) Soil Screening Value.*
[c]Screening level calculated using the EPA RSL calculator (https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search).
µg/L = micrograms per liter
BRLTN = Burlington Air National Guard
ID = identification
SS = surface soil
bgs = below ground surface
ft. = foot or feet
J = reported concentration is an estimated value

Table 13 Building 60 Current Fire Station AFFF Area 3 Subsurface Soil Analytical Results

	Sample ID	BRLTN03-001-SO-014	BRLTN03-002-SO-015
	Date Collected	04/18/17	04/18/17
	Depth (ft. bgs)	13 - 14	14 - 15
Analyte	Screening Level (µg/kg)	Result (µg/kg)	Result (µg/kg)
Perfluorobutane sulfonate (PFBS)	1,300,000[a]	**0.37 J**	**0.49 J**
Perfluorooctanoic acid (PFOA)	300[b]	**1.0**	**0.54 J**
Perfluorooctane sulfonate (PFOS)	1,260[c]	**140**	**110**

Bold values indicate analyte detected at concentration indicated.
[a]EPA Regional Screening Levels (RSLs) for Residential Soil (November 2017) (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017)
[b]Vose, Sarah. Memorandum to Chuck Schwer, March 2016. *Perfluorooctanoic acid (PFOA) Soil Screening Value.*
[c]Screening level calculated using the EPA RSL calculator (https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search).
µg/kg = micrograms per kilogram
BRLTN = Burlington Air National Guard Base
ID = identification
SO = subsurface soil
bgs = below ground surface
ft. = foot or feet
J = reported concentration is an estimated value

Soil Physiochemical Analyses

To provide basic soil parameter information, composite surface soil and subsurface soil samples were collected from Building 60 soil borings and submitted for pH, TOC, and grainsize analysis. The surface soil sample (BRLTN03-004-SS-001) was composed of equal aliquots of soil collected from borings BRLTN03-001 and BRLTN03-002 at 6 inches bgs. The subsurface soil sample (BRLTN03-004-SO-016) was composed of equal aliquots of soil collected from the same borings at 14 feet and 15 feet bgs, respectively. Table F-1 summarizing the physiochemical data and supporting laboratory data sheets are included in Appendix F.

Groundwater

Two groundwater samples were also collected from temporary wells installed at borings BRLTN03-001 and BRLTN03-002 at the current fire station. PFBS was detected in both samples at concentrations of 2.5

µg/L and 1.8 µg/L, below the 400 µg/L screening level. PFOA and PFOS were detected at combined concentrations of 62 µg/L and 66.97 µg/L, above the 0.02 µg/L screening level. Groundwater analytical results are summarized in Table 14 and shown on Figure 13 in Appendix A.

Table 14 Building 60 Current Fire Station (AFFF Area 3) Groundwater Analytical Results

	Sample ID	BRLTN03-001-GW-022	BRLTN03-002-GW-022
	Date Collected	04/20/17	04/20/17
	Depth (ft. btoc)	22	22
Analyte	Screening Level (µg/L)	Result (µg/L)	Result (µg/L)
Perfluorobutane sulfonate (PFBS)	400[a]	**2.5**	**1.8**
Perfluorooctanoic acid (PFOA)	0.02[b]	**2.0**	**0.97**
Perfluorooctane sulfonate (PFOS)	0.02[b]	**60**	**66**
PFOS +PFOA	0.02[b]	**62**	**66.97**

Bold values indicate analyte detected at concentration indicated.
Shaded values indicate analyte exceeds screening criteria.
[a]EPA Regional Screening Levels for Residential Soil (November 2017) [https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017]
[b]Vermont Department of Environmental Conservation, December 2016. Chapter 12 of the Environmental Protection Rules, *"Groundwater Protection Rule and Strategy."*
µg/L = micrograms per liter
btoc = feet below top of casing
GW = groundwater
BRLTN = Burlington Air National Guard
ft. = foot or feet
ID = identification

Sediment

One sediment sample was collected from a drainage ditch approximately 300 feet northeast of Building 60 at BRLTN03-003. PFBS was detected in the sample at an estimated concentration of 0.43 µg/kg, and PFOS was detected at a concentration of 63 µg/kg, both below their respective screening levels. PFOA was not detected in the sample. Analytical results are summarized in Table 15 and shown on Figure 12 in Appendix A.

Table 15 Building 60 Current Fire Station (AFFF Area 3) Sediment Analytical Results

	Sample ID	BRLTN03-003-SD-001
	Date Collected	04/18/17
	Depth (ft. bgs)	0 - 0.5
Analyte	Screening Level (µg/kg)	Result (µg/kg)
Perfluorobutane sulfonate (PFBS)	1,300,000[a]	**0.43 J**
Perfluorooctanoic acid (PFOA)	300[b]	0.66 U
Perfluorooctane sulfonate (PFOS)	1,260[c]	**63**

Bold values indicate analyte detected at concentration indicated.
[a]EPA Regional Screening Levels (RSLs) for Residential Soil (November 2017) [https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017]
[b]Vose, Sarah, State Toxicologist, Vermont Department of Health. Memorandum to Chuck Schwer, Director of Waste Management, Vermont Department of Environmental Conservation, March 2016. *Perfluorooctanoic acid (PFOA) Soil Screening Value.*
[c]Screening level calculated using the EPA RSL calculator (https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search).
µg/kg = micrograms per kilogram
BRLTN = Burlington Air National Guard
J = reported concentration is an estimated value
U = analyte was not detected above the reported value
bgs = below ground surface
ID = identification
SD = sediment

Surface Water
A surface water sample was also collected from the drainage ditch northeast of Building 60 at BRLTN03-003. PFBS was detected in the sample at an estimated concentration of 0.19 µg/L, below the 400 µg/L screening level. PFOA and PFOS were detected at an estimated combined concentration of 13.096 µg/L, above the 0.02 µg/L screening level. Analytical results are summarized in Table 16 and shown on Figure 13 in Appendix A.

Table 16 Building 60 Current Fire Station (AFFF Area 3) Surface Water Analytical Results

	Sample ID	BRLTN03-003-SW-001
	Date Collected	04/18/17
Analyte	Screening Level (µg/L)	Result (µg/L)
Perfluorobutane sulfonate (PFBS)	400[a]	**0.19 J**
Perfluorooctanoic acid (PFOA)	0.02[b]	**0.096 J**
Perfluorooctane sulfonate (PFOS)	0.02[b]	**13**
PFOS +PFOA	0.02[b]	**13.096 J**

Bold values indicate analyte detected at concentration indicated.
Shaded values indicate analyte exceeds screening criteria.
[a]EPA Regional Screening Levels for Residential Soil (November 2017) (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017)
[b]Vermont Department of Environmental Conservation, December 2016. Chapter 12 of the Environmental Protection Rules, "Groundwater Protection Rule and Strategy."
µg/L = micrograms per liter
ID = identification
SW = surface water
BRLTN = Burlington Air National Guard
J = reported concentration is an estimated value

3.3.5 Conclusions

At least one documented AFFF spill at the current fire station has resulted in a release of PFAS to the environment. Combined PFOA and PFOS concentrations were above screening levels in both groundwater samples and the surface water sample. The maximum combined PFOA and PFOS concentration was 66.97 µg/L in groundwater and an estimated 13.096 µg/L in surface water. PFOA and PFOS concentrations in soil and sediment were below screening levels, and PFBS was not detected above screening levels in any sampled media at AFFF Area 3.

3.4 Fire Department Equipment Testing Area – AFFF Area 4

3.4.1 Sample Locations

To assess possible PFAS impacts from the release of AFFF during annual firefighting equipment testing, four surface soil samples, four subsurface soil samples, and five groundwater samples (four primary and one duplicate) were collected. Surface soil and subsurface soil samples were collected from soil boring BRLTN04-001 on the upgradient side of the area (southwest of Taxiway F) and from BRLTN04-002, BRLTN04-003, and BRLTN04-004 on the downgradient side (northeast of Taxiway F). Groundwater samples were collected from each boring; however, because of access limitations on the airfield, grab samples were collected from SP16 drive point samplers rather than by installing temporary monitoring wells. Sample locations are shown on Figure 6 in Appendix A.

3.4.2 Lithology

The four soil borings completed at AFFF Area 4 were terminated at depths ranging from 15 to 20 feet bgs. Soils encountered in these borings included silty sand (USCS – SM), well-graded sand (USCS – SW), and poorly graded sand (USCS – SP). Detailed boring logs are included in Appendix C.

3.4.3 Groundwater Flow

Temporary monitoring wells could not be installed at AFFF Area 4 because of airfield access limitations; therefore, groundwater flow direction could not be determined during this sampling event. Area 4 boring logs indicate groundwater was detected between 10 and 14 feet bgs during drilling. Based on groundwater flow determinations at nearby AFFF Areas 2 and 3 on April 21, 2017, it is anticipated that groundwater at the testing area also flows to the northeast as shown on Figure 6 in Appendix A.

3.4.4 Analytical Results

Surface Soil

Four surface soil samples were collected from soil borings BRLTN04-001 through BRLTN04-004 at the fire department equipment test area. PFBS was not detected in the samples. PFOA was detected in three samples at concentrations ranging from an estimated 0.71 µg/kg to 1.8 µg/kg. PFOS was detected in all four samples at estimated concentrations ranging from 4.3 µg/kg to 42 µg/kg. All PFBS, PFOA, and PFOS detections were below their respective screening levels, as summarized in Table 17 and shown on Figure 14 in Appendix A.

Table 17 Fire Department Equipment Test Area (AFFF Area 4) Surface Soil Analytical Results

	Sample ID	BRLTN04-001-SS-001	BRLTN04-002-SS-001	BRLTN04-003-SS-001	BRLTN04-004-SS-001
	Date Collected	04/20/17	04/20/17	04/20/17	04/20/17
	Depth (ft. bgs)	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5
Analyte	**Screening Level (µg/kg)**	**Result (µg/kg)**	**Result (µg/kg)**	**Result (µg/kg)**	**Result (µg/kg)**
Perfluorobutane sulfonate (PFBS)	1,300,000[a]	0.53 UJ	0.60 UJ	0.60 U	0.53 UJ
Perfluorooctanoic acid (PFOA)	300[b]	0.53 UJ	**0.71 J**	**1.8**	**0.94 J**
Perfluorooctane sulfonate (PFOS)	1,260[c]	**4.3 J**	**42 J**	**36**	**18 J**

Bold values indicate analyte detected at concentration indicated.
[a]EPA Regional Screening Levels (RSLs) for Residential Soil (November 2017) (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017).
[b]Vose, Sarah. Memorandum to Chuck Schwer, March 2016. *Perfluorooctanoic acid (PFOA) Soil Screening Value.*
[c]Screening level calculated using the EPA RSL calculator (https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search).
µg/kg = micrograms per kilogram
BRLTN = Burlington Air National Guard
ID = identification
SS = surface soil
bgs = below ground surface
ft. = foot or feet
J = reported concentration is an estimated value
U = analyte was not detected above the reported value

Subsurface Soil

Four subsurface soil samples were collected from soil borings BRLTN04-001 through BRLTN04-004. PFBS was not detected in the samples. PFOA was detected in one sample (at BRLTN04-002) at an estimated concentration of 0.46 μg/kg. PFOS was detected in three samples at concentrations ranging from an estimated 6.0 μg/kg to 800 μg/kg. All PFOA and PFOS detections were below their respective screening levels, as summarized in Table 18 and shown on Figure 14 in Appendix A.

Table 18 Fire Department Equipment Test Area (AFFF Area 4) Subsurface Soil Analytical Results

	Sample ID	BRLTN04-001-SO-009	BRLTN04-002-SO-010	BRLTN04-003-SO-011	BRLTN04-004-SO-013
	Date Collected	04/20/17	04/20/17	04/20/17	04/20/17
	Depth (ft. bgs)	8 – 9	9 - 10	10 - 11	12 - 13
Analyte	Screening Level (μg/kg)	Result (μg/kg)	Result (μg/kg)	Result (μg/kg)	Result (μg/kg)
Perfluorobutane sulfonate (PFBS)	1,300,000[a]	0.66 UJ	0.56 U	0.60 UJ	0.60 UJ
Perfluorooctanoic acid (PFOA)	300[b]	0.66 UJ	**0.46 J**	0.60 UJ	0.60 UJ
Perfluorooctane sulfonate (PFOS)	1,260[c]	0.66 UJ	**800**	**40 J**	**6.0 J**

Bold values indicate analyte detected at concentration indicated.
[a]EPA Regional Screening Levels (RSLs) for Residential Soil (November 2017) (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017).
[b]Vose, Sarah. Memorandum to Chuck Schwer, March 2016. *Perfluorooctanoic acid (PFOA) Soil Screening Value.*
[c]Screening level calculated using the EPA RSL calculator (https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search).
μg/kg = micrograms per kilogram
ft. = foot or feet
J = reported concentration is an estimated value
U = analyte was not detected above the reported value
bgs = below ground surface
ID = identification
SO = subsurface soil

Soil Physiochemical Analyses
To provide basic soil parameter information, composite surface soil and subsurface soil samples were collected from AFFF Area 4 soil borings and submitted for pH, TOC, and grainsize analysis. The surface soil sample (BRLTN04-005-SS-001) was composed of equal aliquots of soil collected from borings BRLTN04-001 through BRLTN04-004 at 6 inches bgs. The subsurface soil sample (BRLTN04-005-SO-012) was composed of equal aliquots of soil collected from the same borings at depths ranging from 9 feet to 13 feet. Table F-1 summarizing the physiochemical data and supporting laboratory data sheets are included in Appendix F.

Groundwater
Four primary groundwater samples and one duplicate sample were also collected from soil borings BRLTN04-001 through BRLTN04-004 using an SP16 drive point sampler. PFBS was detected in all five samples at concentrations ranging from an estimated 0.0052 μg/L to 0.044 μg/L, below the 400 μg/L screening level. PFOA and PFOS were also detected in all five samples at combined concentrations ranging from an estimated 0.0641 μg/L to 0.322 μg/L, above the 0.020 μg/L screening level. PFBS, PFOA, and PFOS analytical results are summarized in Table 19 and shown on Figure 15 in Appendix A.

3.4.5 Conclusions

Annual testing of fire equipment using AFFF has resulted in releases of PFAS to the environment at the test area on Taxiway F. Combined PFOA and PFOS concentrations exceeded the screening level in each of five samples collected (four primary and one duplicate) with a maximum concentration of 0.322 μg/L. PFOA and PFOS concentrations in soil and sediment samples were below screening levels, and PFBS was not detected above screening levels in any sampled media at AFFF Area 4.

Table 19 Fire Department Equipment Test Area (AFFF Area 4) Groundwater Analytical Results

	Sample ID	BRLTN04-001-GW-013	BRLTN04-002-GW-018	BRLTN04-003-GW-018	BRLTN04-004-GW-018	BRLTN04-004-GW-918 (dup)
	Date Collected	04/20/17	04/20/17	04/20/17	04/20/17	04/20/17
	Depth (ft. bgs)	13	18	18	18	18
Analyte	Screening Level (µg/L)	Result (µg/L)	Result (µg/L)	Result (µg/L)	Result (µg/L)	Result (µg/L)
Perfluorobutane sulfonate (PFBS)	400[a]	**0.013 J**	**0.0052 J**	**0.016 J**	**0.039**	**0.044**
Perfluorooctanoic acid (PFOA)	0.02[b]	**0.084**	**0.0081 J**	**0.023**	**0.061**	**0.062**
Perfluorooctane sulfonate (PFOS)	0.02[b]	**0.10**	**0.056**	**0.24**	**0.26**	**0.26**
PFOS +PFOA	0.02[b]	**0.184**	**0.0641 J**	**0.263**	**0.321**	**0.322**

Bold values indicate analyte detected at concentration indicated.
Shaded values indicate analyte exceeds screening criteria.
[a]EPA Regional Screening Levels for Residential Soil (November 2017) (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017).
[b]Vermont Department of Environmental Conservation, December 2016. Chapter 12 of the Environmental Protection Rules, *"Groundwater Protection Rule and Strategy."*
µg/L = micrograms per liter
BRLTN = Burlington Air National Guard Base
ft. = foot or feet
ID = identification
bgs = below ground surface
dup = field duplicate
GW = groundwater
J = reported concentration is an estimated value

3.5 F-16 EMERGENCY RESPONSE SITE – AFFF AREA 5

3.5.1 Sample Locations

To assess possible PFAS impacts from the use of AFFF to extinguish an F-16 fire, four surface soil samples (three primary and one duplicate), four subsurface soil samples (three primary and one duplicate), and three groundwater samples (two primary and one duplicate) were collected. Surface soil and subsurface soil samples were collected from soil boring BRLTN05-001 on the upgradient side of the area (southwest of Runway 15/33) and from BRLTN05-002 and BRLTN05-003 on the downgradient side (northeast side of Runway 15/33). Groundwater samples were collected from borings BRLTN05-001 and BRLTN05-002, however, because of access limitations on the airfield, grab samples were collected using SP16 drive point samplers rather than temporary monitoring wells. A groundwater sample could not be collected from boring BRLTN05-003 because the boring refused at a depth of 28 feet before encountering groundwater. Sample locations are shown on Figure 7 in Appendix A.

3.5.2 Lithology

The three soil borings completed at AFFF Area 5 were terminated at depths ranging from 19 to 36 feet bgs. Soils encountered at these borings included silty sand (USCS – SM), well-graded sand (USCS – SW), poorly graded sand (USCS – SP), silty clay (USCS – CL), and silt (USCS – ML). Detailed boring logs are included in Appendix C.

3.5.3 Groundwater Flow

Temporary monitoring wells could not be installed at AFFF Area 5 because of airfield access limitations; therefore, groundwater flow direction could not be verified. Area 5 boring logs indicate groundwater was detected at 19 feet bgs at BRLTN05-001 and 36 feet in BRLTN05-002 during drilling. Based on groundwater level measurements collected in 2010 in other nearby areas (CH2MHill, March 2010), groundwater likely flows north/northeast as shown on Figure 7 in Appendix A.

3.5.4 Analytical Results

Surface Soil
Three primary surface soil samples and one duplicate sample were collected from soil borings BRLTN05-001 through BRLTN05-003 at AFFF Area 5. PFBS and PFOA were not detected in the samples. PFOS was detected in all four samples at estimated concentrations ranging from 0.78 µg/kg to 2.7 µg/kg, below the 1,260 µg/kg screening level. PFBS, PFOA, and PFOS analytical results are summarized in Table 20 and shown on Figure 16 in Appendix A.

Subsurface Soil
Three primary subsurface soil samples and one duplicate sample were collected from soil borings BRLTN05-001 through BRLTN05-003. PFBS, PFOA, and PFOS were not detected in the samples. Subsurface soil analytical results are summarized in Table 21 and shown on Figure 16 in Appendix A.

Table 20 F-16 Emergency Response (AFFF Area 5) Surface Soil Analytical Results

	Sample ID	BRLTN05-001-SS-001	BRLTN05-001-SS-901 (dup)	BRLTN05-002-SS-001	BRLTN05-003-SS-001
	Date Collected	04/19/17	04/19/17	04/19/17	04/19/17
	Depth (ft. bgs)	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5
Analyte	Screening Level (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)
Perfluorobutane sulfonate (PFBS)	1,300,000[a]	0.58 UJ	0.59 UJ	0.52 U	0.49 UJ
Perfluorooctanoic acid (PFOA)	300[b]	0.58 U	0.59 UJ	0.52 U	0.49 UJ
Perfluorooctane sulfonate (PFOS)	1,260[c]	**0.78 J**	**0.97 J**	**1.2**	**2.7 J**

Bold values indicate analyte detected at concentration indicated.
[a]EPA Regional Screening Levels for Residential Soil (November 2017) (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017).
[b]Vose, Sarah. Memorandum to Chuck Schwer, March 2016. *Perfluorooctanoic acid (PFOA) Soil Screening Value.*
[c]Screening level calculated using the EPA RSL calculator (https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search).
µg/kg = micrograms per kilogram
BRLTN = Burlington Air National Guard Base
ft. = foot or feet
J = reported concentration is an estimated value
U = analyte was not detected above the reported value
bgs = below ground surface
dup = field duplicate
ID = identification
SS = surface soil

Table 21 F-16 Emergency Response (AFFF Area 5) Subsurface Soil Analytical Results

	Sample ID	BRLTN05-001-SO-014	BRLTN05-002-SO-028	BRLTN05-002-SO-928 (dup)	BRLTN05-003-SO-032
	Date Collected	04/19/17	04/19/17	04/19/17	04/19/17
	Depth (ft. bgs)	13 - 14	27 - 28	27 - 28	31 - 32
Analyte	Screening Level (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)	Result (µg/kg)
Perfluorobutane sulfonate (PFBS)	1,300,000[a]	0.60 UJ	0.60 UJ	0.60 UJ	0.60 UJ
Perfluorooctanoic acid (PFOA)	300[b]	0.60 UJ	0.60 UJ	0.60 UJ	0.60 UJ
Perfluorooctane sulfonate (PFOS)	1,260[c]	0.60 UJ	0.60 UJ	0.60 UJ	0.60 UJ

Bold values indicate analyte detected at concentration indicated.
[a]EPA Regional Screening Levels (RSLs) for Residential Soil (November 2017) (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017).
[b]Vose, Sarah. Memorandum to Chuck Schwer, Director of Waste Management, Vermont Department of Environmental Conservation, March 2016. *Perfluorooctanoic acid (PFOA) Soil Screening Value.*
[c]Screening level calculated using the EPA RSL calculator (https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search).
µg/kg = micrograms per kilogram
BRLTN = Burlington Air National Guard Base
ft. = foot or feet
J = reported concentration is an estimated value
U = analyte was not detected above the reported value.
bgs = below ground surface
dup = field duplicate
ID = identification
SO = subsurface soil

Soil Physiochemical Analyses

To provide basic soil parameter information, composite surface soil and subsurface soil samples were collected from AFFF Area 5 soil borings and submitted for pH, TOC, and grainsize analysis. The surface soil sample (BRLTN05-004-SS-001) was composed of equal aliquots of soil collected from borings BRLTN05-001, BRLTN05-002, and BRLTN05-003 at 6 inches bgs. The subsurface soil sample

(BRLTN05-004-SO-024) was composed of equal aliquots of soil collected from the same borings at depths of 14 feet, 28 feet, and 32 feet, respectively. Table F-1 summarizing the physiochemical data and supporting laboratory data sheets are included in Appendix F.

Groundwater

Two primary groundwater samples and one duplicate sample were collected from soil borings BRLTN05-001 and BRLTN05-002 using a drive point sampler. PFBS was detected in all three samples at estimated concentrations ranging from 0.0062 µg/L to 0.016 µg/L, below the 400 µg/L screening level. PFOA and PFOS were also detected in all three samples at estimated combined concentrations ranging from 0.028 µg/L to 0.294 µg/L, all above the 0.02 µg/L screening level.

The analytical results for each of the three groundwater samples at AFFF Area 5 were qualified during the quality control process ("J flagged") by the validator, indicating estimated but usable data. PFOA and PFOS results for sample BRLTN05-001-GW-017 and BRLTN05-002-GW-933 were flagged because of low surrogate recoveries in laboratory control samples. The PFOA and PFOS results for sample BRLTN05-002-GW-033 were flagged because the results were below the limit of quantification (LOQ). Low surrogate recoveries indicate a potentially biased low result; however, the analytes were detected at concentrations above screening levels (either individually or when combined), indicating a release has occurred based on the reported concentrations. Similarly, when results were below the LOQ, the combined value also exceeded the screening level.

PFBS, PFOA, and PFOS groundwater analytical results are summarized in Table 22 and shown on Figure 17 in Appendix A.

Table 22 F-16 Emergency Response (AFFF Area 5) Groundwater Analytical Results

	Sample ID	**BRLTN05-001-GW-017**	**BRLTN05-002-GW-033**	**BRLTN05-002-GW-933 (dup)**
	Date Collected	**04/19/17**	**04/19/17**	**04/19/17**
	Depth (ft. bgs)	**17**	**33**	**33**
Analyte	**Screening Level (µg/L)**	**Result (µg/L)**	**Result (µg/L)**	**Result (µg/L)**
Perfluorobutane sulfonate (PFBS)	400[a]	**0.0062 J**	**0.016 J**	**0.012 J**
Perfluorooctanoic acid (PFOA)	0.02[b]	**0.054 J**	**0.017 J**	**0.021 J**
Perfluorooctane sulfonate (PFOS)	0.02[b]	**0.24 J**	**0.011 J**	**0.020 J**
PFOS +PFOA	0.02[b]	**0.294 J**	**0.028 J**	**0.041 J**

Bold values indicate analyte detected at concentration indicated.
Shaded values indicate analyte exceeds screening criteria.
[a]EPA Regional Screening Levels for Residential Soil (November 2017) (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2017).
[b]Vermont Department of Environmental Conservation, December 2016. Chapter 12 of the Environmental Protection Rules, "Groundwater Protection Rule and Strategy."
µg/L = micrograms per liter
BRLTN = Burlington Air National Guard Base
ft. = foot or feet
ID = identification
bgs = below ground surface
dup = field duplicate
GW = groundwater
J = reported concentration is an estimated value

3.5.5 Conclusions

Use of AFFF during an F-16 emergency response has resulted in a release of PFAS to the environment near the cable arrest system on the runway. PFOA and PFOS concentrations in soil and sediment were below screening levels. Combined PFOA and PFOS concentrations exceeded the screening level in each of the three groundwater samples collected (two primary and one duplicate) with a maximum estimated concentration of 0.294 µg/L. PFBS was not detected above screening levels in any sampled media at AFFF Area 5.

3.6 Investigation-Derived Waste

3.6.1 Waste Soil

Waste soil generated during the installation of soil borings was placed in two Department of Transportation (DOT)-approved steel drums and staged at AFFF Area 1 for waste sampling and proper disposal. A representative sample was collected from the waste soil, submitted to the project laboratory, and analyzed for PFAS and Toxicity Characteristic Leaching Procedure (TCLP) for VOCs, SVOCs, pesticides, herbicides, metals, polychlorinated biphenyls, total petroleum hydrocarbons, flashpoint, corrosivity (pH), sulfide, and cyanide. The analytical results will be used to develop a waste profile and shipping manifest. Final disposal of investigation-derived waste (IDW) will be determined at that time. Waste manifests will be included in Appendix E.

3.6.2 Wastewater

Wastewater generated during groundwater sampling and decontamination activities was placed in one DOT-approved steel drum and staged at AFFF Area 1 for waste sampling and proper disposal. A representative sample was collected from the waste fluids and submitted to the project laboratory to be analyzed for PFAS and the full TCLP list. The analytical results will be used to develop a waste profile and shipping manifest. Final disposal of IDW will be determined at that time. Waste manifests will be included in Appendix E.

3.6.3 General Waste

General waste – such as paper, plastic, trash, and personal protective equipment – was placed in plastic garbage bags and placed in an on-site dumpster for disposal at an off-site Resource Conservation and Recovery Act Subtitle D industrial landfill.

4.0 GROUNDWATER PATHWAY

The objective of groundwater sampling during the SI was to determine if groundwater in the individual areas had been impacted by the release of AFFF and whether concentrations of PFBS, PFOA, and PFOS remain in groundwater at concentrations exceeding the calculated human health-based screening levels.

Burlington Air National Guard Base Hydrogeology

The uppermost water-bearing zone at Burlington ANG occurs under unconfined (water table) conditions in deltaic glaciofluvial sands and silts. This surficial water-bearing zone is underlain by a potentially confining to semiconfining lacustrine clay layer present across much of the Base. A second deeper water-bearing zone occurs within glacial till and the underlying limestone and marble bedrock of the Ordovician Bascom Formation bedrock. A generalized stratigraphic column is included as Figure 18 in Appendix A.

The vertical hydraulic gradient at the Base is generally downward and the till/bedrock aquifer appears to be connected hydraulically to the overlying surficial aquifer. Shallow groundwater generally flows to the northeast toward (and may discharge to) the Winooski River (Roy F. Weston, Inc., March 1986; Earth Technology, May 1991; HAZWRAP, August 1997; Parsons, June 2002; CH2MHill, March 2010; ANG, December 2011). Slug testing conducted at IRP Site 1 (AFFF Area 1) has indicated hydraulic conductivities ranging from 0.056 feet per day (Earth Technology, May 1991) to 7.87 feet per day (Parsons, June 2002). Depths to groundwater in overburden wells vary from less than 5 feet to more than 60 feet bgs (CH2MHill, March 2010).

The bedrock surface in the vicinity of the Base is irregular and ranges from surface outcrops (off-Base north of AFFF Area 1) to more than 80 feet bgs (HAZWRAP, August 1997). Bedrock groundwater primarily occurs within the carbonate solution features, faults, and fractures. Local bedrock wells have water yields ranging from 6 to 40 gallons per minute. The Vermont Department of Water Resources has classified the bedrock groundwater in the area of Burlington ANG Base as Class III water resource suitable for domestic water supply, irrigation, agricultural use, and general industrial and commercial use. The Base and surrounding areas purchase potable water from the Champlain Water District, which obtains its public water supply from Lake Champlain. No groundwater supply wells are on the Base.

Although several drinking water wells, owned by either private or local government entities, were identified within a 4-mile radius of the approximate center point of the Base, none appear to be downgradient from the Base (CH2MHill, October 2015; Vermont Natural Resources, September 2017).

Six documented private bedrock water wells (Well Nos. 6, 58, 59, 93, 205, and 223) are within an approximate 1-mile radius of the center of the Base as shown on Figure 19 and in Table 23. Wells 58 and 59 are within ¼ mile of the northern boundary of the Base (north of and sidegradient to AFFF Area 1). Well No. 58 is listed as a domestic well, and Well No. 59 is listed as an agricultural well in the Vermont Well Completion Searchable Database. Well No. 6 (listed as a domestic well in the database) is in a residential area southwest of the airport and approximately ½ mile southwest of (and upgradient from) the Base boundary. It is unknown if Well #6 is in use or how water from the well is used. The remaining wells (93, 205, and 223) are east of the Winooski River and are also listed as domestic wells in the database (Vermont Department of Conservation, October 2017; Vermont Agency of Natural Resources, September 2017). Groundwater flow in the area of these wells is expected to be to the south toward the Winooski River.

Table 23 Summary of Private Wells within Approximately 1 Mile of Burlington ANG Base

Well Number	Well Type	Well Depth (feet)	Casing Length (feet)	Depth to Bedrock (feet)	Well Yield (gpm)	Screened Interval	Year Completed
6	Domestic	158	111	100	4	Open hole	1968
58	Domestic	374	94	92	25	Open hole	1983
59	Agricultural	128	102	93	40	Open hole	1983
93	Domestic	143	69	64	7	Open hole	1975
205	Domestic	468	33	27	30	Open hole	1980
223	Domestic	243	68	61	6	Open hole	1981

Notes: Well data from available (post-1965) Vermont Department of Conservation water well completion reports. Listed wells are within an approximate 1-mile radius of the center of the Base.
gpm = gallons per minute

Wells #58 and #59 are on a dairy farm north of the Base and south of the Winooski River. Information provided by the Base indicates that VDEC personnel collected a water sample from a tap in a barn adjacent to the location shown by VDEC as Well #58. However, VDEC could not confirm the identification of the well sampled. Well #58 is classified as "domestic" in the database but is primarily used for agricultural purposes. The well identified as Well #59 (classified as "agricultural") could not be located and, according to the owner of the property, Well #59 does not exist, and there is no well at the location shown in the VDEC well database. Given these uncertainties, it is unclear which well (#58 or

#59) exists and was sampled. Preliminary unvalidated results for the sample collected by VDEC indicate elevated levels of PFOS; however, the final results for this sample are pending at the time of this report.

4.1 Former Fire Training Area 1 (Installation Restoration Program Site 1) – AFFF Area 1

Shallow groundwater at FTA 1 flows to the northeast toward the Winooski River as shown on Figure 9 in Appendix A. Since installation of a groundwater collection trench in 2004 to address chlorinated VOCs (Parsons, August 2004), groundwater from FTA 1 has been collected in the trench and pumped to the WWTP. A pretreatment system was installed at FTA 1 in July 2017 by others to address PFOA and PFOS in groundwater (CH2MHill, June 2017). The previous permitted discharge to the WWTP was discontinued, and treated groundwater (below the Vermont enforcement standard of 0.02 µg/L) was directed to an existing infiltration gallery at the site. Shallow groundwater downgradient of the trench, beyond the influence of the collection trench, flows to the northeast toward the Winooski River.

Analytical results show that combined PFOA and PFOS concentrations in all eight groundwater samples collected at AFFF Area 1 were above the 0.02 µg/L screening level. PFOA and PFOS were detected in three groundwater samples collected at the source area at combined concentrations ranging from 5.7 µg/L in sample BRLTN01-002-GW-015 to 72 µg/L in sample BRLTN01-MW-BP3-012. PFOA and PFOS were also detected in three wells downgradient from the groundwater collection trench at combined concentrations ranging from 4.75 µg/L in sample BRLTN01-MW102-011 to 21.4 µg/L in duplicate sample BRLTN01-MW103-909. PFOA and PFOS were also detected in a sample collected from the collection trench sump (BRLTN01-TRENCHSUMP-001) at a concentration of 19.2 µg/L.

No public water supply wells and no known domestic drinking water wells are downgradient from FTA 1 between the area and the Winooski River, the presumed groundwater discharge point. However, given that Well #58 (north and sidegradient from AFFF Area 1) has been impacted by PFAS, the groundwater pathway (for impacted groundwater from the Base) may be complete. In addition, PFAS-impacted groundwater may be discharging to the Winooski River. The river is approximately 1,200 feet northeast of the collection trench, and the nearest impacted monitoring well (MW-102 with a combined PFOA and PFOS concentration 4.75 µg/L) is downgradient from the trench and approximately 750 feet southwest of the river.

4.2 Building 90 Former Fire Station – AFFF Area 2

Shallow groundwater at the former fire station flows to the east/northeast as shown on Figure 11 in Appendix A. As indicated on Figure 11 in Appendix A, PFOA and PFOS were detected in three groundwater samples above the 0.02 µg/L screening level, at combined concentrations ranging from 9.48 µg/L in sample BRLTN02-003-GW-032 to 54.5 µg/L in sample BRLTN02-002-GW-029.

No public water supply wells and no known domestic drinking water wells are downgradient from the former fire station between the area and the Winooski River, the presumed groundwater discharge point. Therefore, there are no immediate human exposure risks from the presence of PFOA and PFOS in shallow groundwater, and the human ingestion pathway is incomplete. PFAS-impacted groundwater may, however, be discharging to the Winooski River, approximately 2,100 feet to the northeast.

4.3 BUILDING 60 CURRENT FIRE STATION – AFFF AREA 3

Shallow groundwater at the current fire station flows to the east/northeast as shown on Figure 13 in Appendix A. Analytical results showed PFOA and PFOS were detected at combined concentrations above the 0.02 µg/L screening level in two groundwater samples collected at the fire station. Combined PFOA and PFOS concentrations were 62 µg/L in sample BRLTN03-001-GW-022 and 66.97 µg/L in sample BRLTN03-002-GW-022.

No public water supply wells and no known domestic wells are downgradient from the current fire station between the area and the Winooski River, the presumed groundwater discharge point. Therefore, despite the presence of PFOA and PFOS in shallow groundwater, the human ingestion pathway is incomplete. PFAS-impacted groundwater may, however, be discharging to the Winooski River, approximately 2,200 feet to the northeast.

4.4 FIRE DEPARTMENT EQUIPMENT TESTING AREA – AFFF AREA 4

Shallow groundwater at the fire department equipment testing area flows to the northeast as shown on Figure 15 in Appendix A. Analytical results showed PFOA and PFOS were detected above the 0.02 µg/L screening level in five groundwater samples collected at the equipment testing area at combined concentrations ranging from an estimated 0.0641 µg/L in sample BRLTN04-002-GW-018 to 0.322 µg/L in duplicate sample BRLTN04-004-GW-918.

No known domestic wells are downgradient from the fire department equipment testing area between the area and the Winooski River, the presumed groundwater discharge point. Therefore, despite the presence of PFOA and PFOS in shallow groundwater, the human ingestion pathway is incomplete. PFAS-impacted groundwater may, however, be discharging to the Winooski River, approximately 2,600 feet to the northeast.

4.5 F-16 EMERGENCY RESPONSE SITE – AFFF AREA 5

Shallow groundwater at the F-16 emergency response site flows to the north as shown on Figure 17 in Appendix A. Analytical results showed PFOA and PFOS were detected above the 0.02 µg/L screening level in three groundwater samples collected at the area at estimated combined concentrations ranging from 0.028 µg/L in sample BRLTN05-002-GW-033 to 0.294 µg/L in sample BRLTN05-001-GW-017.

No known domestic wells are directly downgradient from the F-16 emergency response site (between the site and the Winooski River to the north, the presumed groundwater discharge point). The nearest domestic well, Well #58, is approximately ½ mile northeast of Area 5 and down/side gradient of the area. Therefore, despite the presence of PFOA and PFOS in shallow groundwater, the human ingestion pathway is incomplete. PFAS-impacted groundwater may, however, be discharging to the Winooski River, approximately 4,100 feet to the north.

5.0 SURFACE WATER PATHWAY

The objective of surface water sampling during the SI was to determine if surface water in the individual areas had been impacted by the release of AFFF and whether concentrations of PFBS, PFOA, and PFOS remain in surface water at concentrations exceeding the calculated human health-based screening levels.

Surface water drainage at Burlington ANG Base occurs through numerous streams along the western and northern boundaries of the Burlington airport with predominant drainage northward to the Winooski

River. Muddy Brook flows along the eastern airport north boundary toward the Winooski River. Intermittent drainages may seasonally flow along the eastern airport boundary with discharge toward the Winooski River (ASL, August 2017). The PA (CH2MHill, October 2015) indicates surface water from each of the five AFFF areas ultimately discharges north toward the Winooski River.

The Winooski River empties into Lake Champlain, approximately 16 river miles downstream of the northwestern end of the Base. Although Lake Champlain is the primary source of drinking water for the Base and surrounding areas, there are no surface water intakes within 15 river miles downstream of the Base (Vermont Agency of Natural Resources, September 2017).

5.1 FORMER FIRE TRAINING AREA 1 (INSTALLATION RESTORATION PROGRAM SITE 1) – AFFF AREA 1

FTA 1 is relatively flat with both grassed and unvegetated bare areas. Surface runoff at FTA 1 occurs as sheet flow, primarily collecting in low areas or draining to the intermittent stream to the south and east. The intermittent stream channel is less than 2 feet wide and less than 0.5 feet deep and empties into a marshy area northeast of National Guard Avenue at Outfall SDO-002.

As shown on Figure 9 in Appendix A, one primary sample (BRLTN01-003-SW-001) and one duplicate surface water sample (BRLTN01-003-SW-901) were collected from the intermittent stream near Outfall SDO-002. PFOA and PFOS were detected above the 0.02 µg/L screening level in both samples at combined concentration of 35.3 µg/L and 38.4 µg/L respectively.

Surface water from FTA 1 does not appear to be directly discharging to the Winooski River. Surface water may, however, be infiltrating shallow groundwater. Further delineation is needed to determine if impacted groundwater may be discharging to the river. However, because no surface water intakes are within 15 river miles downstream of the Base, the human ingestion pathway is incomplete.

5.2 BUILDING 90 FORMER FIRE STATION – AFFF AREA 2

The area surrounding Building 90 is a relatively flat grassed lawn area. Surface runoff from the area flows to stormwater inlets northeast and north of the building and discharges to an open drainage ditch on the south side of Mustang Pass, approximately 960 feet to the east/northeast. Flow from the ditch continues to the east/northeast toward Outfall SDO-001 and the Winooski River.

As indicated on Figure 11 in Appendix A, one surface water sample (BRLTN02-004-SW-001) collected from the drainage ditch on the south side of Mustang Pass and downstream from the site. PFOA and PFOS were detected above the 0.02 µg/L screening level at a combined concentration of 0.081 µg/L.

Surface water from Building 90 discharges to the Winooski River via Outfall SD0-001. In addition, discharge of PFOA- and PFOS-impacted groundwater to the river (though undetermined) is possible. However, because no surface water are intakes within 15 river miles downstream of the Base, the human ingestion pathway is incomplete.

5.3 BUILDING 60 CURRENT FIRE STATION – AFFF AREA 3

The area surrounding Building 60 is a relatively flat lawn. Surface water runoff enters stormwater inlets southeast, northeast, and northwest of the building and discharges into the intermittent stream on the north side of NCO Drive. The intermittent stream flows along the southern limits of FTA 1 (which is northeast of Building 60) and empties into a marshy area northeast of National Guard Avenue at Outfall SDO-002.

As indicated on Figure 13 in Appendix A, one surface water sample (BRLTN03-003-SW-001) was collected from an intermittent stream downstream from the site. PFOA and PFOS were detected above the 0.02 μg/L screening level at a combined concentration of 13.096 μg/L.

Although surface water from the current fire station does not appear to be directly discharging to the Winooski River, surface water may be infiltrating the subsurface and impacting shallow groundwater. In addition, discharge of PFOA- and PFOS-impacted groundwater to the river (though undetermined), is possible. However, because no surface water are intakes within 15 river miles downstream of the Base, the human ingestion pathway is incomplete.

5.4 Fire Department Equipment Testing Area – AFFF Area 4

The fire department equipment testing area includes a section of Taxiway F and surrounding level grassed areas. No stormwater inlets, ditches, or standing water are near the test area. Any runoff from the area would largely occur as sheet flow and likely infiltrate into the ground surface. No surface water samples were collected at AFFF Area 4.

Although surface water was not present at the testing area, discharge of impacted groundwater to the river (though undetermined) is possible. However, because no surface water intakes are within 15 river miles downstream of the Base, the human ingestion pathway is incomplete.

5.5 F-16 Emergency Response Site – AFFF Area 5

The F-16 emergency response site includes a section of Runway 15/33 and surrounding level grassed areas. No stormwater inlets, ditches, or standing water are near the emergency response site. Any runoff from the area would largely occur as sheet flow and likely infiltrate into the ground surface. No surface water samples were collected at AFFF Area 5.

Although surface water was not present at the testing area, discharge of impacted groundwater to the river (though undetermined) is possible. However, because no surface water intakes are within 15 river miles downstream of the Base, the human ingestion pathway is incomplete.

6.0 SOIL AND SEDIMENT EXPOSURE AND AIR PATHWAYS

The objective of soil sampling during the SI was to determine if soils in the individual areas had been impacted by the release of AFFF and whether concentrations of PFBS, PFOA, and PFOS remain in the soils exceeding the calculated human health-based screening levels.

6.1 Former Fire Training Area 1 (Installation Restoration program Site 1) – AFFF Area 1

Where detected, PFAS concentrations in subsurface soil samples and a sediment sample collected at former FTA 1 were below screening levels, as indicated on Tables 3 and 5. Lacking concentrations of PFAS above screening levels, the soil and air pathways are incomplete at AFFF Area 1. Surface soil was not sampled at FTA 1 because soil had been excavated from the area during a previous remediation effort.

6.2 BUILDING 90 FORMER FIRE STATION – AFFF AREA 2

Where detected, PFAS concentrations in surface soil, subsurface soil, and sediment samples collected at the former fire station site were below screening levels (see Tables 7, 8, and 10). Lacking concentrations of PFAS above screening levels, the soil and air pathways are incomplete at AFFF Area 2.

6.3 BUILDING 60 CURRENT FIRE STATION – AFFF AREA 3

Where detected, PFAS concentrations in surface soil, subsurface soil, and the sediment sample collected at the current fire station site were below screening levels (see Tables 12, 13, and 15). Lacking concentrations of PFAS above screening levels, the soil and air pathways are incomplete at AFFF Area 3.

6.4 FIRE DEPARTMENT EQUIPMENT TESTING AREA – AFFF AREA 4

Where detected, PFAS concentrations in surface soil and subsurface soil samples collected at the fire department equipment testing area were below screening levels (see Tables 17 and 18). Lacking concentrations of PFAS above screening levels, the soil and air pathways are incomplete at AFFF Area 4.

6.5 F-16 EMERGENCY RESPONSE SITE – AFFF AREA 5

Where detected, PFAS concentrations in surface soil and subsurface soil samples collected at the emergency response site were below screening levels (see Tables 20 and 21). Lacking concentrations of PFAS above screening levels, the soil and air pathways are incomplete at AFFF Area 4.

7.0 UPDATES TO CONCEPTUAL SITE MODELS

The following sections contain updates to the conceptual site models for AFFF Areas 1 through 5 and address PFOA and PFOS in soil, groundwater, surface water, and sediment. PFBS was not detected above screening levels in any sampled media and will not be discussed further.

7.1 FORMER FIRE TRAINING AREA 1 (INSTALLATION RESTORATION PROGRAM SITE 1) – AFFF AREA 1

The QAPP addendum (ASL, August 2017) identified subsurface soil, groundwater, sediment, and surface water as media potentially impacted by previous releases of AFFF at FTA 1. As indicated in Sections 3.1.4 and 6.1, PFOA and PFOS concentrations in subsurface soil and sediment (where detected) were below screening levels and do not represent a complete human exposure pathway.

PFOA/PFAS concentrations in groundwater and surface water however, exceeded screening levels, as indicated in Section 3.1.4. Although there are no drinking water wells between AFFF Area 1 and the Winooski River, Well #58 (north and sidegradient from AFFF Area 1) has been impacted by PFAS. As indicated in Section 4.1, the groundwater pathway (for impacted groundwater from the Base) may be complete.

Although PFOA- and PFOS-impacted surface water from FTA 1 does not appear to be directly discharging to the Winooski River, infiltration of surface water to shallow groundwater is possible. Further delineation is needed to determine if impacted groundwater from FTA 1 is discharging to the river. However, because no surface water intakes are within 15 river miles downstream of the Base, the ingestion pathway is also incomplete for surface water, as indicated in Section 5.1.

7.2 Building 90 Former Fire Station – AFFF Area 2

The QAPP addendum identified surface soil, subsurface soil, groundwater, sediment, and surface water as media potentially impacted by previous releases of AFFF at the former fire station. As indicated in Sections 3.2.4 and 6.2, PFOA/PFAS concentrations in subsurface soil and sediment (where detected) were below screening levels and do not represent a complete human exposure pathway.

PFOA and PFOS concentrations in groundwater and surface water, however, exceeded screening levels, as indicated in Section 3.2.4. The human ingestion pathway for groundwater is incomplete, as indicated in Section 4.2.

PFOA- and PFOS-impacted surface water from Building 90 eventually discharges to the Winooski River via Outfall SD0-001 and impacted groundwater may also be discharging to the river. However, because no surface water intakes are within 15 river miles downstream of the Base, the ingestion pathway is also incomplete for surface water, as indicated in Section 5.2.

7.3 Building 60 Current Fire Station – AFFF Area 3

The QAPP addendum identified surface soil, subsurface soil, groundwater, sediment, and surface water as media potentially impacted by previous releases of AFFF at the current fire station. As indicated in Sections 3.3.4 and 6.3, PFOA/PFAS concentrations in surface soil, subsurface soil, and sediment (where detected) were below screening levels and do not represent a complete human exposure pathway.

PFOA/PFAS concentrations in groundwater and surface water, however, exceeded screening levels, as indicated in Section 3.3.4. The human ingestion pathway for groundwater is incomplete, as indicated in Section 4.3.

Although surface water from the current fire station does not appear to be directly discharging to the Winooski River, surface water may be infiltrating the subsurface and impacting shallow groundwater. Further delineation is needed to determine if impacted groundwater is discharging to the river. However, because no surface water intakes are within 15 river miles downstream of the Base, the ingestion pathway is also incomplete for surface water, as indicated in Section 5.3.

7.4 Fire Department Equipment Testing Area – AFFF Area 4

The QAPP addendum identified surface soil, subsurface soil, and groundwater as media potentially impacted by previous releases of AFFF at the fire department equipment training area. As indicated in Sections 3.4.4 and 6.4, PFOA/PFAS concentrations in surface soil and subsurface soil (where detected) were below screening levels and do not represent a complete human exposure pathway. Surface water was not present at or near AFFF Area 4.

PFOA/PFAS concentrations in groundwater, however, exceeded screening levels as indicated in Section 3.4.4. The human ingestion pathway for groundwater is incomplete, as indicated in Section 4.4.

Impacted groundwater may also be discharging to the river. However, because no surface water intakes are within 15 river miles downstream of the Base, the ingestion pathway is also incomplete for surface water, as indicated in Section 5.4.

7.5 F-16 EMERGENCY RESPONSE SITE – AFFF AREA 5

The QAPP addendum identified surface soil, subsurface soil, and groundwater as media potentially impacted by previous releases of AFFF at the F-16 emergency response site. As indicated in Sections 3.5.4 and 6.5, PFOA/PFAS concentrations in surface soil and subsurface soil (where detected) were below screening levels and do not represent a complete human exposure pathway. Surface water was not present at or near AFFF Area 5. PFOA/PFAS concentrations in groundwater, however, exceeded screening levels, as indicated in Section 3.5.4. The human ingestion pathway for groundwater is incomplete, as indicated in Section 4.5.

Impacted groundwater may also be discharging to the river. However, because no surface water intakes are within 15 river miles downstream of the Base, the ingestion pathway is also incomplete for surface water as indicated in Section 5.5.

8.0 SUMMARY AND CONCLUSIONS

ASL completed SIs at five known or suspected areas of AFFF releases at Burlington ANG Base as documented in the PA (CH2M HILL, October 2015) and as detailed in the subsequent site-specific QAPP addendum (ASL, February 2017). The areas inspected were

- Former FTA 1 (IRP Site 1) (AFFF Area 1),
- Building 90 Former Fire Station (AFFF Area 2),
- Building 60 Current Fire Station (AFFF Area 3),
- Fire Department Equipment Testing Area (AFFF Area 4), and
- F-16 Emergency Response Site (AFFF Area 5).

All fieldwork was conducted in accordance with the site-specific QAPP addendum (ASL, February 2017) with the following exceptions:

- At AFFF Area 1, existing monitoring well V1-MW-14L was sampled in lieu of planned existing well MW-104, which could not be sampled because of a blockage in the well.
- Temporary monitoring wells could not be installed at AFFF Areas 4 and 5 because of airfield access limitations. Groundwater samples were collected using drive point samplers.

Selected sample media varied for the five sites but included surface soil, subsurface soil, groundwater, sediment, and surface water. Sampling was primarily limited to the immediate areas of known or suspected AFFF releases and biased toward locations most likely to have been impacted by the releases. All samples were analyzed for PFBS, PFOA, and PFOS using modified EPA Method 537. Analytical results for PFBS in soil and sediment were compared to published EPA RSLs. Analytical results for PFOS in soil and sediment were compared to the calculated RSL of 1,260 µg/kg. Analytical results for PFOA in soil and sediment were compared to the VDH screening level of 300 µg/kg. Analytical results for PFBS in groundwater and surface water were compared to the published EPA RSL. Analytical results for PFOA and PFOS in groundwater and surface water were compared to the Vermont Groundwater Enforcement Standard of 0.02 µg/L (for the combined concentrations of PFOA and PFOS).

AFFF use at the Base has resulted in PFOA and PFOS concentrations in groundwater and surface water above screening levels; however, no potential receptor pathways with immediate impacts to human health were identified. Although no immediate impacts were identified, further assessment of PFOA and PFOS impacts at each of the AFFF areas (via expanded SI or remedial investigation [RI]) may be warranted. Table 23 summarizes detected concentrations of PFBS, PFOA, and PFOS for each media sampled at each area. Summaries of key findings and conclusions for each area (focusing on PFOA and PFOS exceedances) are included in Sections 8.1 through 8.5.

Table 24 Summary of PFBS, PFOA, and PFOS Detections and Screening Level Exceedances[1]

AFFF Area	Associated Existing IRP ID	Parameter	Maximum Detected Concentration	Screening Level	Number of Samples / Number of Exceedances	Exceeds Screening Level
AFFF Area 1 Former FTA 1	**Site 1**	**Subsurface Soil**	**(µg/kg)**	**(µg/kg)**		
		PFBS	ND	1,300,000	3/0	No
		PFOA	25	300	3/0	No
		PFOS	1,200 J	1,260	3/0	No
		Groundwater	**(µg/L)**	**(µg/L)**		
		PFBS	3.4	400	9/0	No
		PFOA	**41**	0.02	9/9	**Yes**
		PFOS	**31**	0.02	9/9	**Yes**
		PFOA + PFOS	**72**	0.02	9/9	**Yes**
		Sediment	**(µg/kg)**	**(µg/kg)**		
		PFBS	1.3	1,300,000	2/0	No
		PFOA	2.2	300	2/0	No
		PFOS	180	1,260	2/0	No
		Surface Water	**(µg/L)**	**(µg/L)**		
		PFBS	2.0	400	2/0	No
		PFOA	**1.4**	0.02	2/2	**Yes**
		PFOS	**37**	0.02	2/2	**Yes**
		PFOA + PFOS	**38.4**	0.02	2/2	**Yes**
AFFF Area 2 Building 90 Former Fire Station	**None (New Area)**	**Surface Soil**	**(µg/kg)**	**(µg/kg)**		
		PFBS	0.28 J	1,300,000	4/0	No
		PFOA	0.91 J	300	4/0	No
		PFOS	31 J	1,260	4/0	No
		Subsurface Soil	**(µg/kg)**	**(µg/kg)**		
		PFBS	ND	1,300,000	3/0	No
		PFOA	7.8 J	300	3/0	No
		PFOS	160	1,260	3/0	No
		Groundwater	**(µg/L)**	**(µg/L)**		
		PFBS	0.47	400	3/0	No
		PFOA	**0.50**	0.02	3/3	**Yes**
		PFOS	**54**	0.02	3/3	**Yes**
		PFOA + PFOS	**54.5**	0.02	3/3	**Yes**
		Sediment	**(µg/kg)**	**(µg/kg)**		
		PFBS	ND	1,300,000	1/0	No
		PFOA	ND	300	1/0	No
		PFOS	2.3	1,260	1/0	No
		Surface Water	**(µg/L)**	**(µg/L)**		
		PFBS	0.035	400	1/0	No
		PFOA	ND	0.02	1/0	No
		PFOS	**0.081**	0.02	1/1	**Yes**
		PFOA + PFOS	**0.081**	0.02	1/1	**Yes**
AFFF Area 3 Building 60 Current Fire Station	**None (New Area)**	**Surface Soil**	**(µg/kg)**	**(µg/kg)**		
		PFBS	0.71 J	1,300,000	2/0	No
		PFOA	1.5 J	300	2/0	No
		PFOS	280	1,260	2/0	No
		Subsurface Soil	**(µg/kg)**	**(µg/kg)**		
		PFBS	0.49 J	1,300,000	2/0	No
		PFOA	1.0	300	2/0	No
		PFOS	140	1,260	2/0	No

AFFF Area	Associated Existing IRP ID	Parameter	Maximum Detected Concentration	Screening Level	Number of Samples / Number of Exceedances	Exceeds Screening Level
		Groundwater	**(µg/L)**	**(µg/L)**		
		PFBS	2.5	400	2/0	No
		PFOA	**2.0**	0.02	2/2	**Yes**
		PFOS	**66**	0.02	2/2	**Yes**
		PFOA + PFOS	**66.97**[2]	0.02	2/2	**Yes**
		Sediment	**(µg/kg)**	**(µg/kg)**		
		PFBS	0.43 J	1,300,000	1/0	No
		PFOA	ND	300	1/0	No
		PFOS	63	1,260	1/0	No
		Surface Water	**(µg/L)**	**(µg/L)**		
		PFBS	0.19 J	400	1/0	No
		PFOA	**0.096 J**	0.02	1/1	**Yes**
		PFOS	**13**	0.02	1/1	**Yes**
		PFOA + PFOS	**13.096 J**	0.02	1/1	**Yes**
AFFF Area 4 Fire Department Equipment Testing Area	**None (New Area)**	**Surface Soil**	**(µg/kg)**	**(µg/kg)**		
		PFBS	ND	1,300,000	4/0	No
		PFOA	1.8	300	4/0	No
		PFOS	42 J	1,260	4/0	No
		Subsurface Soil	**(µg/kg)**	**(µg/kg)**		
		PFBS	ND	1,300,000	4/0	No
		PFOA	0.46 J	300	4/0	No
		PFOS	800	1,260	4/0	No
		Groundwater	**(µg/L)**	**(µg/L)**		
		PFBS	0.044	400	5/0	No
		PFOA	**0.084**	0.02	5/4	**Yes**
		PFOS	**0.26**	0.02	5/5	**Yes**
		PFOA + PFOS	**0.322**[2]	0.02	5/5	**Yes**
AFFF Area 5 F-16 Emergency Response Site	**None (New Area)**	**Surface Soil**	**(µg/kg)**	**(µg/kg)**		
		PFBS	ND	1,300,000	4/0	No
		PFOA	ND	300	4/0	No
		PFOS	2.7 J	1,260	4/0	No
		Subsurface Soil	**(µg/kg)**	**(µg/kg)**		
		PFBS	ND	1,300,000	4/0	No
		PFOA	ND	300	4/0	No
		PFOS	ND	1,260	4/0	No
		Groundwater	**(µg/L)**	**(µg/L)**		
		PFBS	0.016 J	400	3/0	No
		PFOA	**0.054 J**	0.02	3/2	**Yes**
		PFOS	**0.24 J**	0.02	3/1	**Yes**
		PFOA + PFOS	**0.294 J**	0.02	3/3	**Yes**

[1] Includes duplicate and resample results.
[2] Maximum PFOA + PFOS concentration shown is the highest combined PFOA and PFOS concentration detected in a specific groundwater sample and in this instance is not the sum of the individual maximum PFOA and PFOS concentrations listed as they occurred in two separate samples.
Bold values exceed screening levels.
µg/L = micrograms per liter
AFFF = aqueous film forming foam
ID = identification
J = estimated concentration
PFBS = perfluorobutane sulfonate
PFOS = perfluorooctane sulfonate
µg/kg = micrograms per kilogram
FTA = fire training area
IRP = Installation Restoration Program
ND = not detected
PFOA = perfluorooctanoic acid

8.1 FORMER FIRE TRAINING AREA 1 (INSTALLATION RESTORATION PROGRAM SITE 1) – AFFF AREA 1

Use of AFFF at FTA 1 between 1970 and 1980 has resulted in PFAS impacts to groundwater above screening levels. Although no public water supply wells and no known domestic wells (drinking water or irrigation) are downgradient from the area, Well #58 (north and sidegradient from FTA 1) has been impacted by PFAS and may represent a complete pathway for impacted groundwater from the Base. Further, although discharge of impacted groundwater to the Winooski River north of the Base is possible, the nearest surface water intake is more than 15 miles downstream.

In addition, a modification to the current groundwater collection system at FTA 1 to treat PFOA and PFOS has been installed by others (CH2MHill, June 2017). Groundwater from the collection trench is treated by routing it through two GAC vessels. Treated groundwater is pumped to infiltration trenches constructed at the site.

8.2 BUILDING 90 FORMER FIRE STATION – AFFF AREA 2

Although releases of AFFF at the former fire station have resulted in PFOA and PFOS in groundwater above screening levels, no complete human receptor pathways have been identified at the former fire station. No public water supply wells and no known domestic wells (drinking water or irrigation) are downgradient from the area. Further, although discharge of impacted groundwater to the Winooski River is possible, the nearest surface water intake is more than 15 miles downstream.

8.3 BUILDING 60 CURRENT FIRE STATION – AFFF AREA 3

Although releases of AFFF at the current fire station have resulted in PFOA and PFOS in groundwater above screening levels, no complete human receptor pathways have been identified at the current fire station. No public water supply wells and no known domestic wells (drinking water or irrigation) are downgradient from the area. Further, although discharge of impacted groundwater to the Winooski River is possible, the nearest surface water intake is more than 15 miles downstream.

8.4 FIRE DEPARTMENT EQUIPMENT TESTING AREA – AFFF AREA 4

Although releases of AFFF at the fire department equipment testing area have resulted in PFOA and PFOS to groundwater above screening levels, no complete human receptor pathways have been identified at the spray test area. No public water supply wells and no known domestic wells (drinking water or irrigation) are downgradient from the area. Although discharge of impacted groundwater to the Winooski River is possible, the nearest surface water intake is more than 15 miles downstream.

8.5 F-16 EMERGENCY RESPONSE SITE – AFFF AREA 5

Although release of AFFF at the F-16 emergency response site has resulted in PFOA and PFOS in groundwater above screening levels, no complete human receptor pathways have been identified at the emergency response site. No public water supply wells and no known domestic wells (drinking water or irrigation) are downgradient from the area. Further, although discharge of impacted groundwater to the Winooski River is possible, the nearest surface water intake is more than 15 miles downstream.

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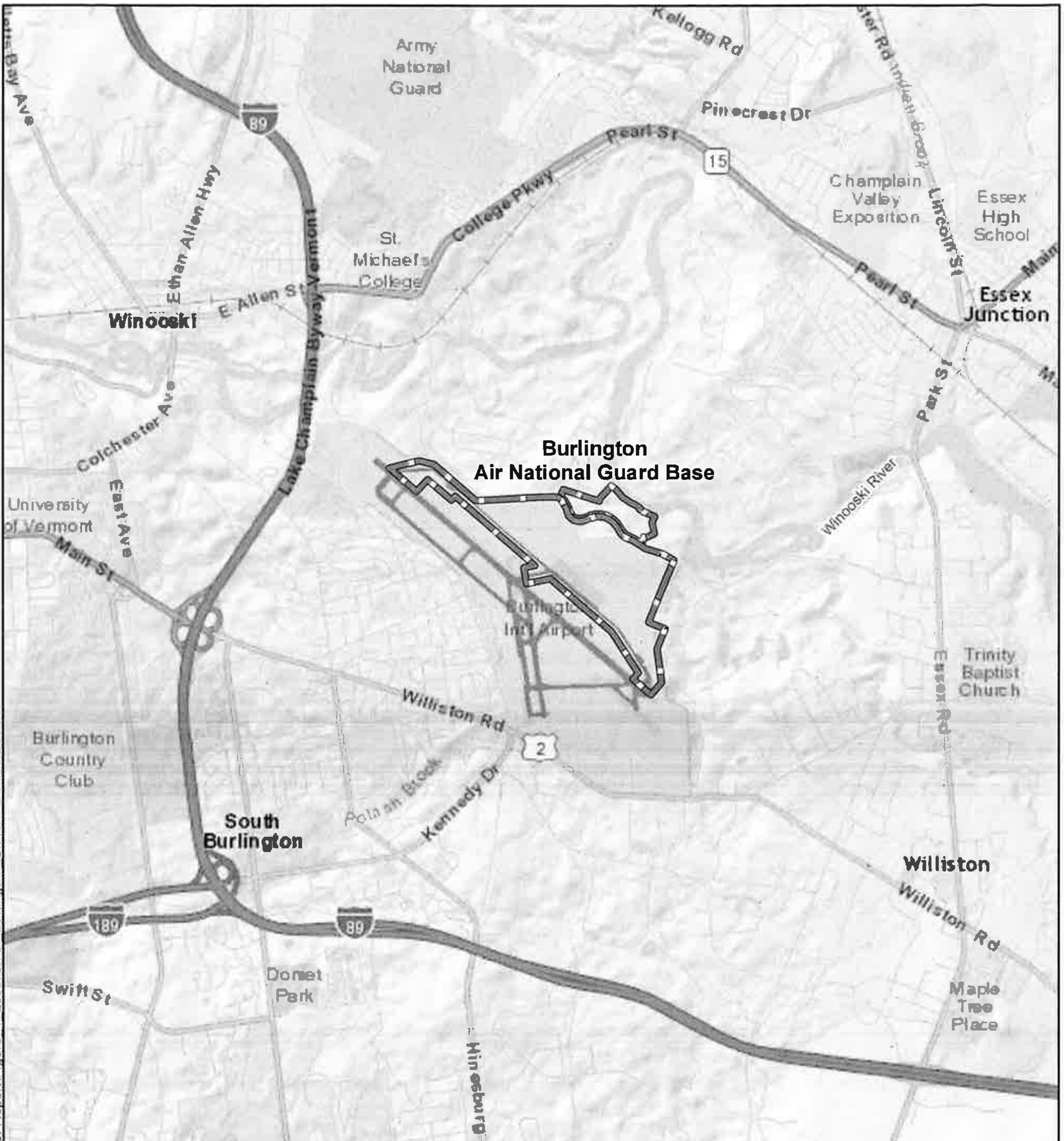
Appendix A
Figures



G:\M2032_0001_Savannah\Burlington\MXD\SI Report\Figure_1_Location of Burlington_SI.mxd Date: 8/29/2017

Figure 1 Location of Burlington Air National Guard Base
Chittenden County, Vermont

Legend

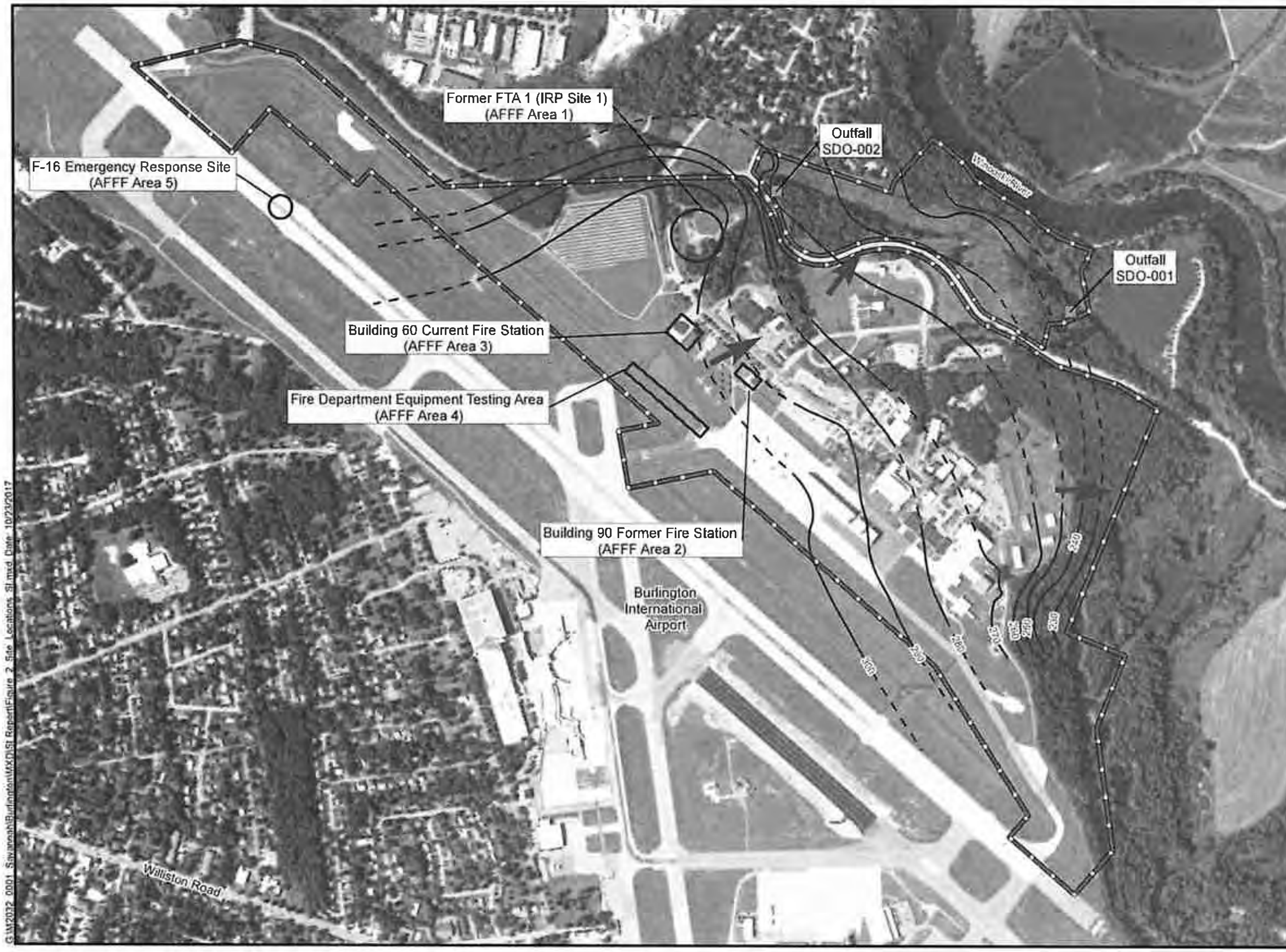
Installation Boundary

Service Layer Credits Esri StreetMap North America

Drawn: tmorse | Date: 8/29/2017

0 1 Miles

N



Legend

- Outfall
- AFFF Inspection Area
- Installation Boundary
- Groundwater Elevation Contour May 2008 (dashed where inferred)*
- Groundwater Flow Direction

*Source: CH2M HILL, March 2010. *Final Remedial Investigation Report – Sites 1, 2, 3, 4, 5A, and 5B, 158th Fighter Wing, Vermont Air National Guard Burlington Air National Guard Base, South Burlington, Vermont*

N

0 350 700
Feet

Burlington Air National Guard Base
Chittenden County, Vermont

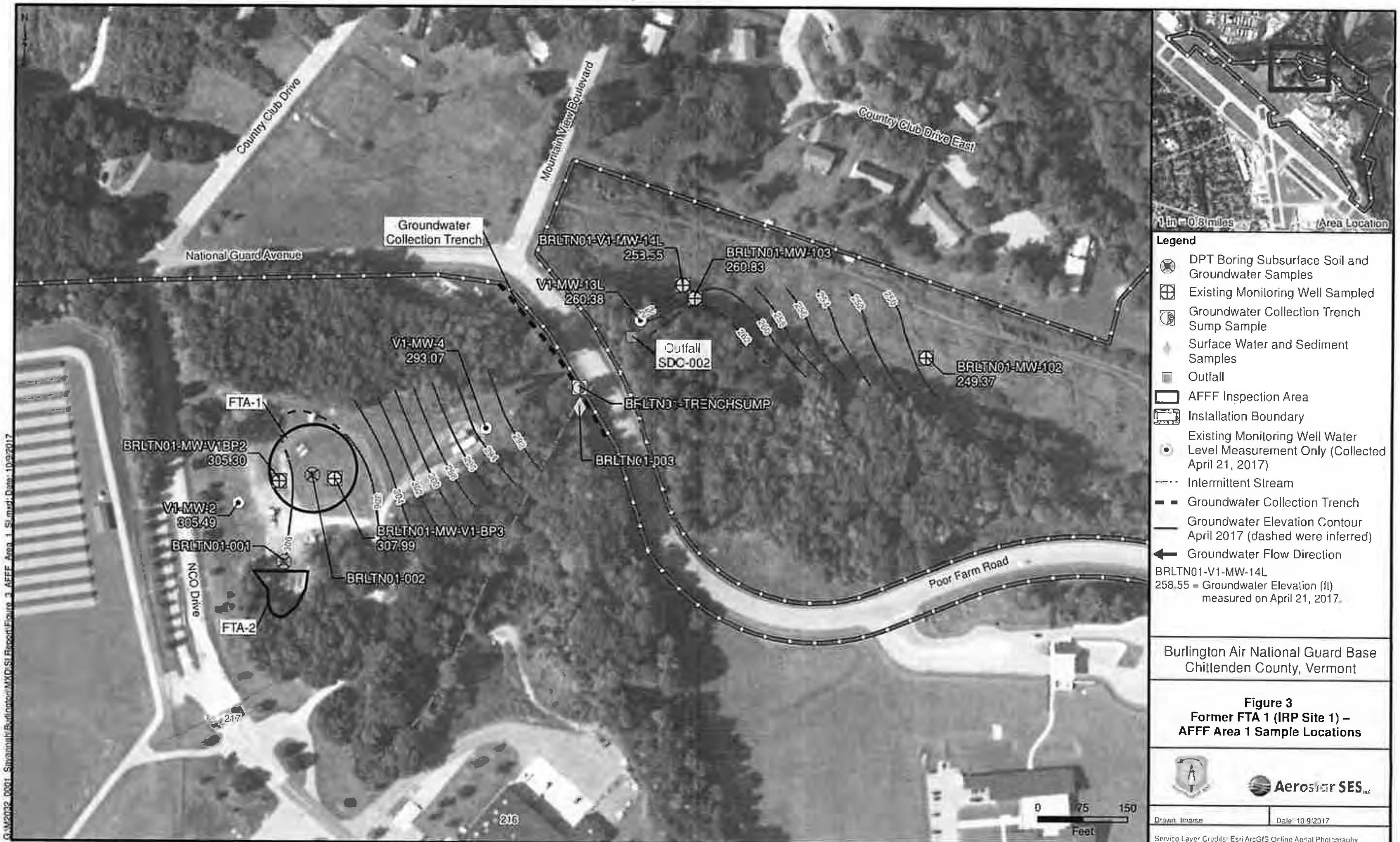
Figure 2
AFFF Area Locations

Aerostar SES

Drawn: lmorse | Date: 10/23/2017

Service Layer Credits: Esri ArcGIS Online Aerial Photography

G:\M2032_0001_Savannah\Burlington\MXD\SI Report\Figure 2 Site Locations SI.mxd Date: 10/23/2017


Country Club Drive
Mountain View Boulevard
Country Club Drive East
National Guard Avenue
Groundwater Collection Trench
BRLTN01-V1-MW-14L
253.55
BRLTN01-MW-103
260.83
V1-MW-13L
260.38
Outfall
SDC-002
V1-MW-4
293.07
BRLTN01-MW-102
249.37
FTA-1
BRLTN01-MW-V1BP2
305.30
V1-MW-2
305.49
BRLTN01-001
BRLTN01-003
BRLTN01-MW-V1-BP3
307.99
BRLTN01-002
FTA-2
NCO Drive
Poor Farm Road
216
217
1 in = 0.8 miles
Area Location
Legend
DPT Boring Subsurface Soil and Groundwater Samples
Existing Monitoring Well Sampled
Groundwater Collection Trench Sump Sample
Surface Water and Sediment Samples
Outfall
AFFF Inspection Area
Installation Boundary
Existing Monitoring Well Water Level Measurement Only (Collected April 21, 2017)
Intermittent Stream
Groundwater Collection Trench
Groundwater Elevation Contour April 2017 (dashed were inferred)
Groundwater Flow Direction
BRLTN01-V1-MW-14L
258.55 = Groundwater Elevation (ft) measured on April 21, 2017.
0 75 150
Feet
Burlington Air National Guard Base
Chittenden County, Vermont
Figure 3
Former FTA 1 (IRP Site 1) –
AFFF Area 1 Sample Locations
Drawn: Imorse
Date: 10/9/2017
Service Layer Credits: Esri ArcGIS Online Aerial Photography

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Poor Farm Road
NCO Drive
Mustang Pass
BRLTN03-002
308.25
BRLTN03-001
308.53
Building 60
BRLTN02-002
300.00
BRLTN02-001
303.36
Building 90
BRLTN02-003
298.66
BRLTN02-004
NCO Drive
299
300
301
302
303
304
305
306
307
308
309
1 in = 0.8 miles
Area Location
Legend
DPT Boring Surface Soil, Subsurface Soil, and Groundwater Samples
Surface Water and Sediment Samples
AFFF Inspection Area
Installation Boundary
Storm Sewer*
Open Ditch
Intermittent Stream
Groundwater Elevation Contour April 2017 (dashed were inferred)
Groundwater Flow Direction
BRLTN02-001
303.36 = Groundwater Elevation (ft) measured on April 21, 2017.
Note: *For clarity, only storm sewers from Buildings 60 and 90 are shown.
0 75 150
Feet
Burlington Air National Guard Base
Chittenden County, Vermont
Figure 4
Building 90 Former Fire Station – AFFF Area 2 Sample Locations
Aerostar SES
Drawn: lmorse
Date: 10/18/2017
Service Layer Credits: Esri ArcGIS Online Aerial Photography

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Legend

- DPT Boring Surface Soil, Subsurface Soil, and Groundwater Samples
- Surface Water and Sediment Samples
- AFFF Inspection Area
- Installation Boundary
- Storm Sewer*
- Intermittent Stream
- Groundwater Elevation Contour April 2017 (dashed were inferred)
- Groundwater Flow Direction

BRLTN03-001
308.53 = Groundwater Elevation (ft) measured on April 21, 2017.

Note: *For clarity, only storm sewers from Buildings 60 and 90 are shown.

0 40 80
Feet

Burlington Air National Guard Base
Chittenden County, Vermont

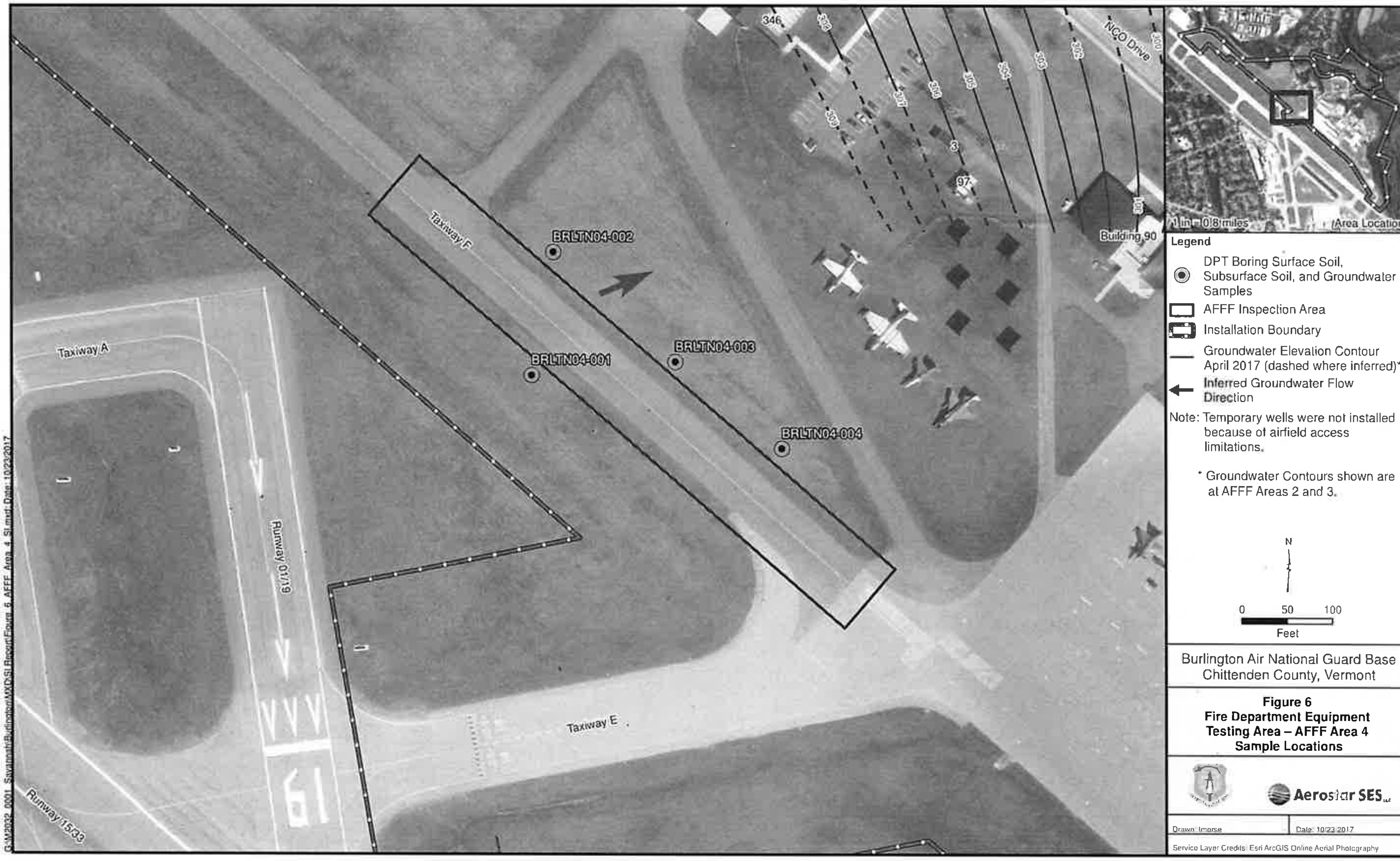
Figure 5
Building 60 Current Fire Station – AFFF Area 3 Sample Locations

Aerostar SES LLC

Drawn: Imorse | Date: 10/23/2017

Service Layer Credits: Esri ArcGIS Online Aerial Photography

G:\M2032.0001 Savannah\Burlington\MXD\SI Report\Figure 5 AFFF Area 3 SI.mxd Date: 10/23/2017



Taxiway F
Taxiway A
Taxiway E
Runway 01/19
Runway 15/33
NCO Drive
Building 90
BRLTN04-001
BRLTN04-002
BRLTN04-003
BRLTN04-004
346
308
307
306
305
304
303
302
300
309
101
97
3
1 in = 0.8 miles
Area Location
Legend
DPT Boring Surface Soil, Subsurface Soil, and Groundwater Samples
AFFF Inspection Area
Installation Boundary
Groundwater Elevation Contour April 2017 (dashed where inferred)*
Inferred Groundwater Flow Direction
Note: Temporary wells were not installed because of airfield access limitations.
* Groundwater Contours shown are at AFFF Areas 2 and 3.
N
0
50
100
Feet
Burlington Air National Guard Base Chittenden County, Vermont
Figure 6
Fire Department Equipment Testing Area – AFFF Area 4 Sample Locations
Aerostar SES LLC
Drawn: Imorse
Date: 10/23/2017
Service Layer Credits: Esri ArcGIS Online Aerial Photography

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