IMMEDIATE RESPONSE ACTION PLAN
Status Report 3

Barnstable Municipal Airport
Hyannis, Massachusetts

RTN 4-26347

April 2018

Prepared for:
Barnstable Municipal Airport
480 Barnstable Road
Hyannis, MA 02840

Prepared by:
Horsley Witten Group, Inc.
90 Route 6A
Sandwich, MA 02563

IMMEDIATE RESPONSE ACTION PLAN STATUS REPORT 3

BARNSTABLE MUNICIPAL AIRPORT
HYANNIS, MASSACHUSETTS
RTN 4-26347

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1.0 INTRODUCTION

The Horsley Witten Group, Inc. (HW) has been retained by the Barnstable Municipal Airport (the Airport) to develop this third Immediate Response Action (IRA) Plan Status Report for its property at 480 Barnstable Road, Hyannis, Massachusetts (Figure 1). HW has prepared this report in accordance with the Massachusetts Contingency Plan 310 CMR 40.0000 (MCP) on behalf of:

Ms. Katie Servis, Assistant Airport Manager
Barnstable Municipal Airport
Hyannis, Massachusetts 02601
(508) 775-2020

The report describes activities between October, 2017 and April, 2017 in the context of previous soil and groundwater sampling and analysis.

2.0 SUMMARY OF IRA PLAN

An IRA was initiated in response to a Notice of Responsibility (NOR) for Release Tracking Number (RTN) 4-26347 dated November 10, 2016, issued to the Airport by the Massachusetts Department of Environmental Protection (DEP). The NOR requested that the Airport conduct additional field investigations to evaluate sources of two types of contaminants previously detected at the Airport and on adjacent properties, and to identify potential impacts to public water supply wells operated by the Hyannis Water District at the Mary Dunn and Maher wellfields.

The NOR specifically requests that the Airport investigate perfluoroalkyl substances (PFAS) including perfluorooctane sulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) previously detected in groundwater at the Airport and several adjacent properties. DEP also requested further evaluation of 1, 4-dioxane, previously detected in a monitoring well downgradient of the Airport on the Maher wellfield property.

A proposed IRA plan was submitted for approval in response to the NOR. Subsequently, a meeting was held by DEP at the Airport that included other stakeholders including the Barnstable Department of Public Works, the Hyannis Water District and Barnstable County representatives (representing the Fire Training Academy). At the meeting, IRA plans were coordinated between the Airport and Fire Training Academy including sampling locations, type of analysis, groundwater modeling, goals and next steps. The IRA plan served as the guide for the soil and groundwater testing conducted since November 2016 to follow up on the results of the previous analyses.

Background

Prior to issuance of the NOR, the Airport conducted investigations on both contaminants and provided results to DEP. In July 2015, HW sampled groundwater from seven wells for analysis of 1,4-dioxane. The contaminant was detected in well OW-9DD at a concentration of 0.93 ug/L, above the 0.30 ug/L groundwater standard for 1,4-dioxane. This well is screened from 77 to 87 feet below the ground surface. Samples taken from the other wells at the Airport did not contain 1,4-dioxane above laboratory reporting levels.

A potential source of 1,4-dioxane at the Airport is a historic release of 1,1,1-trichloroethane (1,1,1-TCA) from an oil water separator associated with a floor drain in the former Provincetown Boston Airlines hangar (currently leased to Cape Air). Given the screen depth of OW-9DD the 1,4,-dioxane may also be from an off airport source.

On August 4, 2016 DEP issued a Request for Information (RFI) to the Airport requiring investigation of PFAS. On July 1 and 5, 2016, HW collected samples from six monitoring wells and submitted samples for laboratory analysis for the presence of PFOS and PFOA. These compounds were detected in each of the wells tested. At monitoring wells HW-3 and HW-5, total PFAS concentrations were 0.084 and 0.12 ug/L respectively, above the EPA health advisory limit and DEP standard of 0.07 ug/L. Because of the extremely low detection requirements, HW collected confirmatory samples from these two wells. Results showed 0.16 ug/l in HW-3 and 0.12 ug/L in HW-5. The concentrations detected in all the other wells were below the standard. It should be noted that these compounds were also detected above the standard in well HW-1, located at the upgradient, western boundary of the Airport.

Actions Under the IRA Plan

A summary of the groundwater and soil sampling and analysis conducted to date for both 1,4-dioxane and the PFAS compounds is provided below. This includes activities between October, 2017 and April 2018 which included the analysis of background PFAS concentrations in soils near the Airport and across the Town of Barnstable and SPLP leaching tests of six PFAS samples from the airport.

3.0 APPLICABLE MCP STANDARDS

In accordance with MCP Section 310 CMR 40.0900, the characterization of risk of harm to health, safety public welfare, and the environment must be evaluated at each disposal site. This characterization includes the determination of site-specific soil and groundwater categories based on site location and use, and the comparison of laboratory results to these standards (310 CMR 40.0930).

Groundwater located within a Current Drinking Water Source Area is considered category GW-1. The Airport is located within several zones of contribution (Zone II) for Barnstable Fire District Water Department, the Hyannis Water District and the Town of Yarmouth. Zone IIs are

considered current drinking water sources as defined in 310 CMR 40.0006; thus category GW-1 is applicable.

Groundwater located within 30 feet of an occupied building that has an average annual depth of less than 15 feet is categorized as GW-2. This is primarily a concern because of the possibility of vapor impacts to indoor air. The average annual depth to groundwater at the site is greater than 15 feet; therefore GW-2 Standards do not apply. Also, all disposal sites shall be considered a potential source of discharge to surface water, and therefore categorized as GW-3. Based on these criteria, categories GW-1 and GW-3 are applicable to this site.

Currently, there are no DEP soil standards for 1,4-dioxane or the PFAS compounds.

4.0 FIELD INVESTIGATIONS – DECEMBER 2016 – APRIL 2018

The field work conducted since the November, 2016 NOR was received by the Airport is summarized below:

- The installation of groundwater monitoring wells at six locations installed in April 2017: in the vicinity of potential sources of PFOA at the Airport Rescue and Fire Fighting (ARFF) Building, at the fire fighting training deployment area adjacent to the East Ramp, and at upgradient locations to evaluate potential off site sources of PFAS and 1,4-dioxane. Groundwater flows from the northwest to southeast across the airport, approximately parallel to Runway 15/33. Figures 2 and 3 provide the locations of monitoring wells used in the analysis to date.

- The first round of groundwater samples for PFAS and 1,4-dioxane were collected on April 5-7 and April 11, 2017. Additional groundwater samples and one surface water sample were collected for analysis of PFAS on June 20, 2017.

- An initial round of three soil samples were taken on December 6, 2016 as reported in the first status report. One sample was taken from each location where it was determined that aircraft fire fighting foam (AFFF) had been used at the Airport, including the site of an airplane crash in 1991, the deployment area, and the drill location along the dirt road adjacent to the deployment area (See Figure 4).

- A second round of soil samples was taken on June 20, 2017 adjacent to the ARFF building and within the deployment area to begin to determine the extent of PFAS within the surface soils. Based on the results of these analyses, a third round of samples from these two locations were collected on September 26, 2017. The third round of sampling was designed to further map the extent of PFAS in soils both horizontally and vertically, with samples taken at the ground surface and at two and four feet below grade.

- In October, 2017 three composite soil samples were taken from piles of sediment and topsoil associated with the redevelopment of Runway 15/33. These piles were located on Airport property at the site of the former Mildred's Restaurant and were analyzed for PFAS compounds to evaluate if sediment removed from the airport as part of this redevelopment contained PFAS. In November, 2017, five additional composite samples of soils from the runway redevelopment were taken from the storage location at Cape Cod Aggregates (Figure 5).

- On October 26, 2017, ten PFAS samples were taken to evaluate background conditions in surficial soils on the Airport and in nearby locations in Hyannis (Figure 5). Ten additional background samples from location across the Town of Barnstable were taken on December 14, 2017 (Figure 6).

- Six PFAS soil samples were also analyzed for leaching potential using an SPLP test. The chosen samples included four samples from within the boundaries of the PFAS sites at the airport and two samples from runway reconstruction soils stockpiled at the airport. Results of these tests were provided to HW by the Laboratory in early January, 2018 (Figure 7).

- Two samples of AFFF have also been analyzed for PFAS compounds to evaluate the foam previously used at the airport and that the foam that is currently in use, which should have reduced concentrations of PFAS compounds.

Groundwater samples were taken in accordance with the Massachusetts Department of Environmental Protection (DEP) Guidance on Sampling and Analysis for PFAS at Disposal Sites Regulated under the MCP, dated January 2017. A submersible pump was utilized to develop each monitoring well prior to sample collection. During well development, a properly calibrated InSitu smarTroll MP multi-parameter meter was utilized to measure temperature, pH, conductivity, DO, and oxidation reduction potential. Samples, including the trip and equipment blanks were submitted to ESS Laboratory, Cranston, Rhode Island for 1,4-dioxane analyses and to Maxim Laboratory for the PFAS compounds. Trip blanks and equipment rinse samples were collected and analyzed for PFAS compounds along with the monitoring well samples.

Soil samples were taken using a hand auger that was decontaminated using Liquinox, and rinsed using Type II De-ionized water. Each boring was advanced to just above the desired depth of sample then the auger was decontaminated and rinsed again prior to sample collection, in order to minimize, to the greatest extent possible, cross contamination between samples/intervals. Each step was repeated in between each interval of sampling. Samples were collected by either shaking the sample directly from the hand auger into the bottle, or, if necessary, using a gloved hand to remove the sample from bottom of the auger and placing directly into bottle. A separate set of gloves was used for each sample.

Results of Groundwater and Soil Analyses

An overview of the testing conducted to date on 1,4-dioxane and PFAS compounds is summarized below. The information is taken from the past two IRA status reports and a report on background conditions submitted to DEP on January 24, 2018. The tables and figures included here provide the details on this data. The laboratory report used to develop the figures and tables were provided in the previous reports and are not duplicated here.

Groundwater Analyses for 1,4-dioxane

Ten groundwater samples were collected in April and analyzed by ESS laboratory for the presence of 1,4-dioxane using Method 8270 SIMS. Wells were sampled from locations hydrologically upgradient of the Airport, at the former source of the 1,1,1-TCA release on the North Ramp, along the path of the plume from this source area, and downgradient of the Airport property at the Maher Wellfield (Table 1 and Figure 2). Upgradient wells were located proximate to the former Packaging Industries site where historic releases of Freon-12 were detected in groundwater that flowed across the Airport towards the Maher Wellfield.

1,4-dioxane was not detected on the Airport property including along the presumed path of the former solvent plume that originated at the oil/water separator adjacent to what is now the Cape Air hangar on the north ramp of the Airport. It was detected in wells OW-9DD, OW-18D and OW-19D on the Maher Wellfield property, at a depth of approximately 80 feet below the water table. HW is planning to install a deep well on airport property upgradient of the Maher Wellfield to further document the boundaries of the current 1,4-dioxane contamination in deep groundwater. This might help determine the ultimate source, be it the Airport, the former Freon release from Packaging Industries or another source. Freon was detected in the past in deep wells on the eastern side of the Airport (that were abandoned during construction of the runway safety zone), as well as at the Maher Wellfield.

Soil Analyses for PFAS Compounds at the Two Airport Sites

Results from the April, September and early October sampling rounds at the Deployment Area an ARFF sites where AFFF was used are summarized in Table 2 and Figure 8. PFAS compounds were detected at the deployment area site where AFFF training has been conducted. Concentrations ranged from 0.4 ug/kg to 39 ug/kg in the shallow soil samples. Concentrations in the samples from two and four feet below grade were lower than those detected at the surface. The highest concentration (39 ug/kg) was detected in surficial soils at the site where regular testing of the fire fighting foam equipment was conducted per Federal Aviation Administration (FAA) requirements. This is where foam was sprayed at a target to confirm the foam system worked properly. The concentration four feet below this surface sample dropped to 22 ug/kg.

The Airport plans to coordinate with DEP on the removal of surficial soils in the deployment area to reduce the future risk to groundwater. The total amount and depth of soil removal

remains to be determined. Following this action, further soil analysis will be conducted to determine if additional remediation is needed.

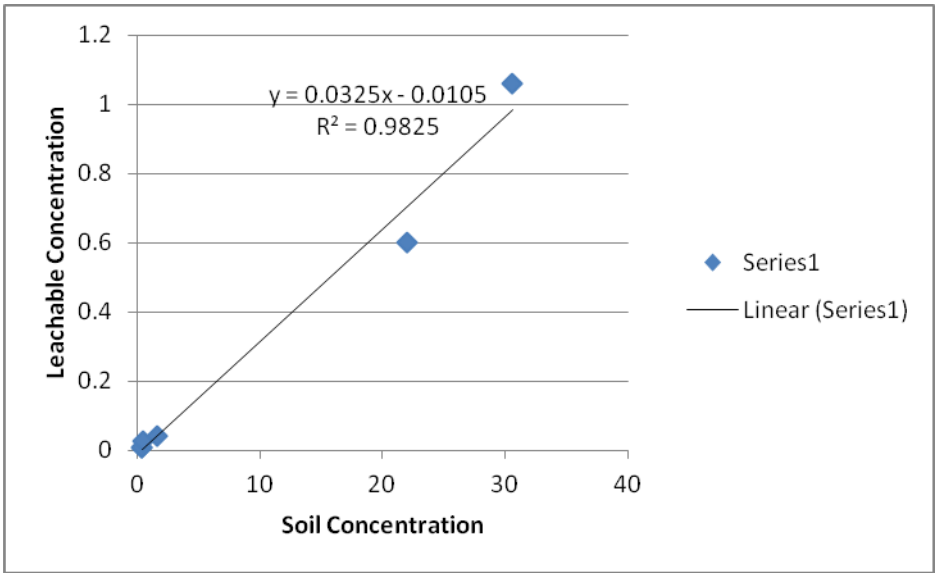
PFAS compounds were also detected in soil and within a catch basin just north of the ARFF building at concentrations ranging from 1.85 to 5.3 ug/kg. Further sampling is needed to refine the extent of contamination in this area. Soil removal is also under consideration for this area.

SPLP Leaching Analyses

Six samples were analyzed using an SPLP test to evaluate the potential for leaching of PFAS compounds to groundwater. They include samples from the deployment area site, and the stockpiled sediments at the airport (Figure 7). The results of the analysis (Table 4) indicate

HW compared the soil concentration from the SPLP samples to the resulting leachate concentrations and found a linear relationship between the two (see graph below). The correlation coefficient (R^2 value) calculated for the graph shown below was 0.98, meaning there is a strong correlation between the soil concentration and the resultant leachate concentration. HW determined that a soil concentration of 2.5 ug/kg could result in a leachate concentration that meets the Massachusetts groundwater standard of 0.07 ug/L.

Comparison of Soil to Leachate Concentrations by SPLP Analyses



It should be noted that the SPLP analyses represent leachate directly from a soil sample near the ground surface. It does not take into account the adsorption of the PFAS compounds to organic carbon in the sediments between where the sample was taken and the underlying groundwater. At the Airport, the groundwater is approximately 25 feet below the ground surface allowing for some uptake of PFAS compounds throughout that distance. Further analysis of the leaching of PFAS compounds at the two AFFF sites will be conducted as part of the Phase II assessments.

Background Investigations

In October and December 2017, HW collected 20 background samples for analysis of PFAS compounds. Ten were taken from the Airport (outside of the two AFFF sites) and the immediate surrounding area. An additional 10 were taken across the Town of Barnstable. Nine of the 20 background samples contained combined PFOS/PFOA concentrations above 1 ug/kg. The average background concentration from these samples is 1.2 ug/kg.

Groundwater Analyses for PFAS Compounds

PFOS/PFOA compounds were detected above the 0.07 ug/L standard in wells HW-E and HW-F at the deployment area at concentrations of 0.100 ug/L and 0.075 ug/L respectively (Table 3 and Figure 3). They were also detected at 0.215 ug/L in well HW-3, downgradient of the ARFF building soil sample locations. Each of these wells is screened at the water table and the results are likely linked to the contamination detected in the overlying soils.

Samples from wells HW-9DD (0.555 ug/L) and HW-18D (0.245 ug/L) at the Maher Wellfield were also above the 0.07 ug/kg standard. Samples from the shallower wells at these two locations contained PFOS/PFOA but at concentrations below the standard. Further analysis is needed to identify if the contamination at the Maher Wellfield is from the Airport, the upgradient Fire Training Academy or a currently unknown source. This will be addressed as part of the Phase II investigations that will begin in the next two months.

PFOS/PFOA were also detected above the standard at well HW-19D south of the Airport parking lot, in well HW-5 adjacent to the Cape Air hangar on the North Ramp, and at well HW-1 upgradient of the Airport. There is no known source that might have contributed PFOS/PFOA to groundwater in these locations, an issue that will be analyzed further moving forward.

5.0 GROUND WATER MODELING AND CONTAMINANT TRANSPORT ANALYSIS

DEP requested that the Airport evaluate if potential sources on the western portion of the Airport could be upgradient of the Mary Dunn Wellfield. To answer this question, HW is using and modifying an existing U.S. Geological Survey groundwater model to evaluate groundwater flow under current and recent historical pumping conditions. This work is ongoing and will be informed by the results of the groundwater sampling and water level data collected under this IRA plan. The model will be used to document what areas of the Airport are upgradient of the Mary Dunn Wellfield. It will also be used to evaluate groundwater flow and contaminant transport from potential source areas on Airport property, as well as groundwater flow from the Fire Training Academy across the Airport to the southeast.

6.0 MANAGEMENT OF REMEDIAL WASTE

No remedial waste has been generated to date as a result of the work conducted under the IRA Plan.

7.0 UPGRADES TO AFFF TESTING PROTOCOLS AT THE AIRPORT

The Airport has purchased two Ecologic Foam Test Systems to allow the Airport to test the AFFF delivery systems on their fire trucks without having to discharge the foam into the environment. These new systems meet the Federal Aviation Administration requirements for the regular testing of AFFF usage. Therefore it is anticipated that no further foam will be deployed at the Airport except during an emergency situation when its use is required.

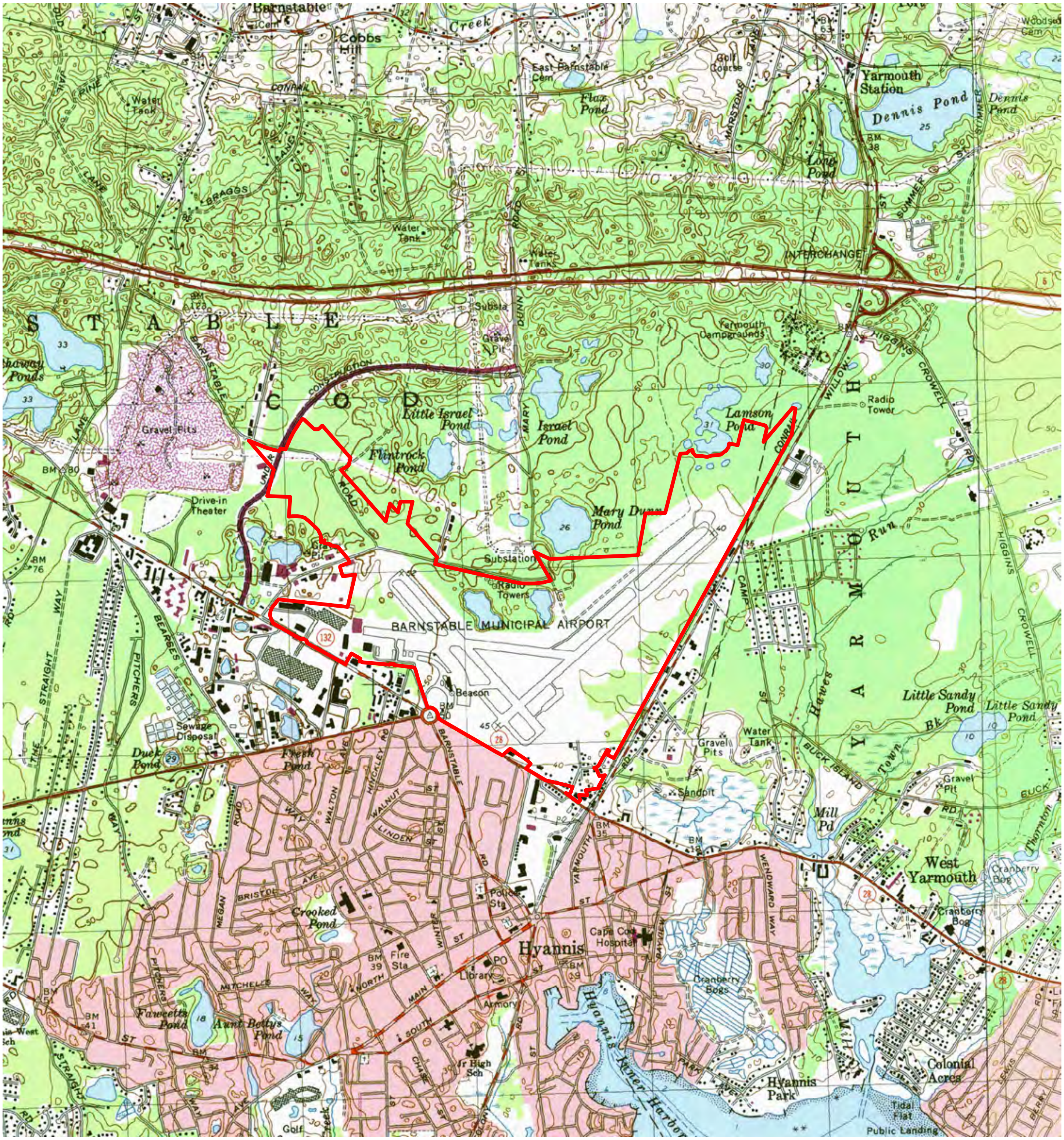
8.0 PLANS FOR NEXT REPORTING PERIOD

Further testing of soil and groundwater is planned as described Phase II Scope of Work included within the Phase I – Initial Site Investigation and Tier Classification Report submitted to DEP November 10, 2017. In addition, as mentioned above, the Airport will be moving forward to remove and dispose of soils from the deployment area in order to minimize leaching of PFOA compounds to groundwater. This work will begin in May 2018 following funding approval by the Town of Barnstable.

DEP asked the Airport to investigate whether or not there are private wells downgradient of the airport and potential source areas for 1,4-dioxane and PFAS compounds. In the IRA Plan, HW identified four properties in Yarmouth that, while connected to public water, also were identified as having an onsite well. Given that they are connected to public water it is likely that these wells are used for non-drinking water purposes and/or abandoned.

HW will continue this evaluation upon receipt of our groundwater sampling data and upon completion of our groundwater modeling analysis to determine if any additional areas need to be investigated for the presence of private wells. If any private wells are identified, further analysis will be conducted to determine if private well sampling is needed.

FIGURES



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Legend

Airport Property Line

**Hyannis Topographic Quadrangle*

N

Miles

0.5

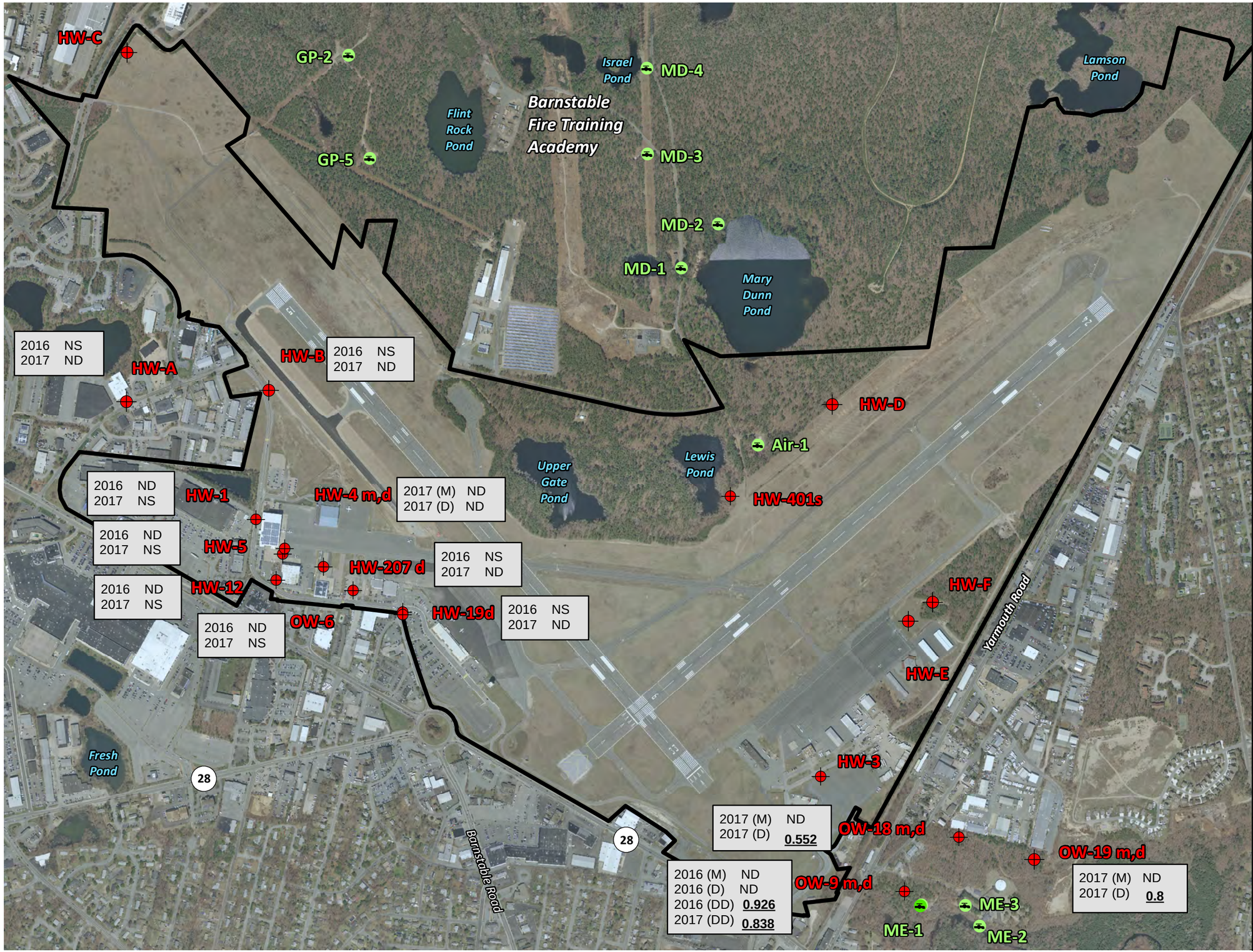
Horsley Witten Group

Sustainable Environmental Solutions

USGS Locus
Barnstable Municipal Airport
Hyannis, MA

Date: 4/17/2018

Figure 1



Legend

- Monitoring Wells
- ND — No Detect
- NS — No Sample Collected
- 0.2 — 1,4 Dioxane Below MassDEP Limit (0.3 ug/L)
- **0.8** — 1,4 Dioxane Above MassDEP Limit (0.3 ug/L)
- Drinking Water Wells
- Barnstable Municipal Airport Property Boundary

N

0 750

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1,4 Dioxane Results in Groundwater Barnstable Municipal Airport Hyannis, MA

Date: 4/17/2018

Figure 2

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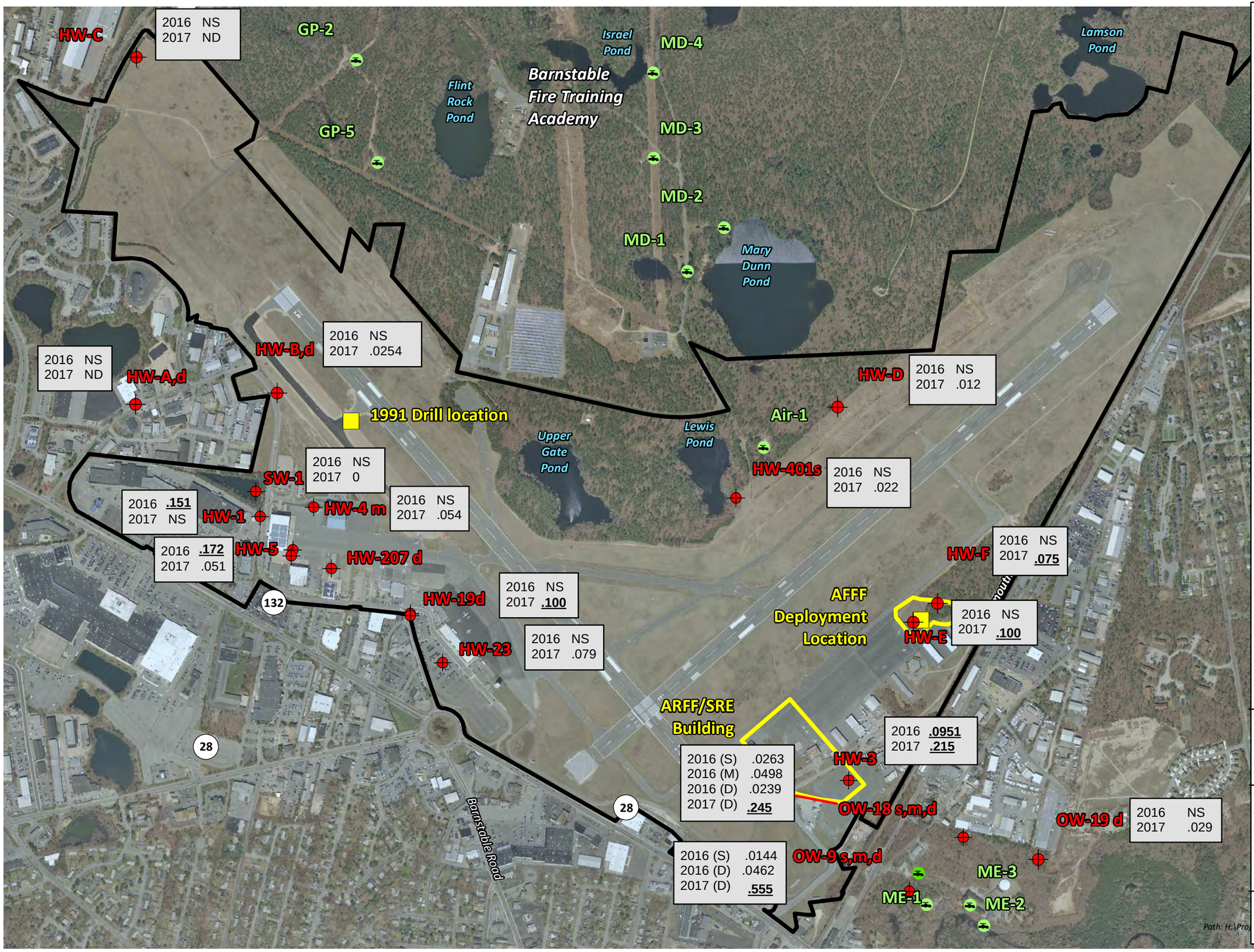

Legend

- Monitoring Wells
- PFOS/PFOA Soil Samples
- ND — No Detect
- NS — No Sample Collected
- .02 — PFOS+PFOA Under EPA Limit (.070 ug/L)
- **.08** — PFOS+PFOA Over EPA Limit (.070 ug/L)
- Drinking Water Wells
- Barnstable Municipal Airport Property Boundary

N

0 750

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PFOS+PFOA Results in Groundwater Barnstable Municipal Airport Hyannis, MA

Date: 4/17/2018 Figure 3

Legend

- Monitoring Wells
- PFOS/PFOA Soil Samples
- Drinking Water Wells
- Barnstable Municipal Airport Property Boundary

N

0 750

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Location of Known ARFF Use and Storage

Date: 4/17/2018 Figure 4

Path: H:\Projects\HYA\17027 BMA PFOS 1-4 IRA\GIS\Maps\170720_PFOS_SoilBorings_locations.mxd

Samples from Cape Cod Aggregates- Runway Reconstruction Soils

	CCA 1	CCA 2	CCA 3	CCA 5	CCA 6
Perfluorooctane sulfonate (PFOS)	0.39J	ND	0.68J	1.4	ND
Perfluorooctanoic acid (PFOA)	ND	ND	ND	ND	ND

BG-1
PFOS ND
PFOA 0.58

BG-6
PFOS 0.32
PFOA ND

BG-3
PFOS 0.38
PFOA ND

BG-5
PFOS 0.41
PFOA 0.47

BG-4
PFOS 2.3
PFOA ND

BG-8
PFOS 0.31
PFOA ND

BG-7
PFOS 0.33
PFOA ND

BG-10
PFOS 0.62
PFOA ND

BG-9
PFOS 1.3
PFOA ND

BG-2
PFOS 0.7
PFOA ND

Stockpile From Runway Reconstruction

	Stockpile West	Stockpile East	Loam Pile
PFOS	0.38	0.39	0.81
PFOA	ND	ND	ND

Legend

- Background PFAS sample locations
- Barnstable Municipal Airport Property Boundary
- ND non detect
- ## Soil Concentration (ug/kg)

N

0 1,750 Feet

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Background
PFAS Sample Locations Near
Barnstable Municipal Airport
Hyannis, MA

Date: 4/17/2018 Figure 5

Path: H:\Projects\HYA\17027 BMA PFOS 1-4 IRA\GIS\Maps\180110_PFOS_BackgroundSampleLocations.mxd

BG-11: Bike Trail
PFOS 0.41
PFOA 0.75

BG-12: Old Stage & Oak Street Intersection
PFOS 0.76
PFOA 0.67

BG-13: Osterville Community Center Lawn
PFOS 0.99
PFOA 0.33

BG-14: Barnstable Senior Center Lawn
PFOS ND
PFOA ND

BG-15: West End Rotary
PFOS 3.1
PFOA 0.46

BG-16: Town Green
PFOS 2
PFOA 0.37

BG-17: Vetans Memorial Park
PFOS 0.36
PFOA 0.36

BG-18: Aselton Park
PFOS 2.3
PFOA 0.50

BG-19: Hathaway's Pond
PFOS 0.41
PFOA 0.25

BG-20: The Hollow Ballpark
PFOS 0.44
PFOA 0.86

Legend

- Background PFOS sample locations
- Barnstable Municipal Airport Property Boundary
- ND non detect
- ## Soil Concentration (ug/kg)

N

0 3,500 Feet

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Background PFAS Sample Locations Across Barnstable, MA

Date: 4/17/2018 Figure 6

Path: H:\Projects\HYA\17027 BMA PFOS 1-4 IRA\GIS\Maps\180110_PFOS_BackgroundSamplesRound2.mxd

*Imagery - ESRI, 2016

Legend

- Current Site Boundary
- PFOS/PFOA Soil Samples
- **ND** Non Detect
- **0.2** Soil Concentration (ug/kg PFOS+PFOA)
- ***0.2*** Lechate Concentration (ug/L PFOS+PFOA)
- **0.07** (ug/L DEP Groundwater Standard)
- Barnstable Municipal Airport Property Boundary

Note:
A field measured concentration in groundwater will vary from the laboratory leachate concentration based upon various field conditions.

N

0 250 Feet

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Soil Leaching Results for PFAS Compounds Barnstable Municipal Airport Hyannis, MA

Date: 4/17/2018 Figure 7

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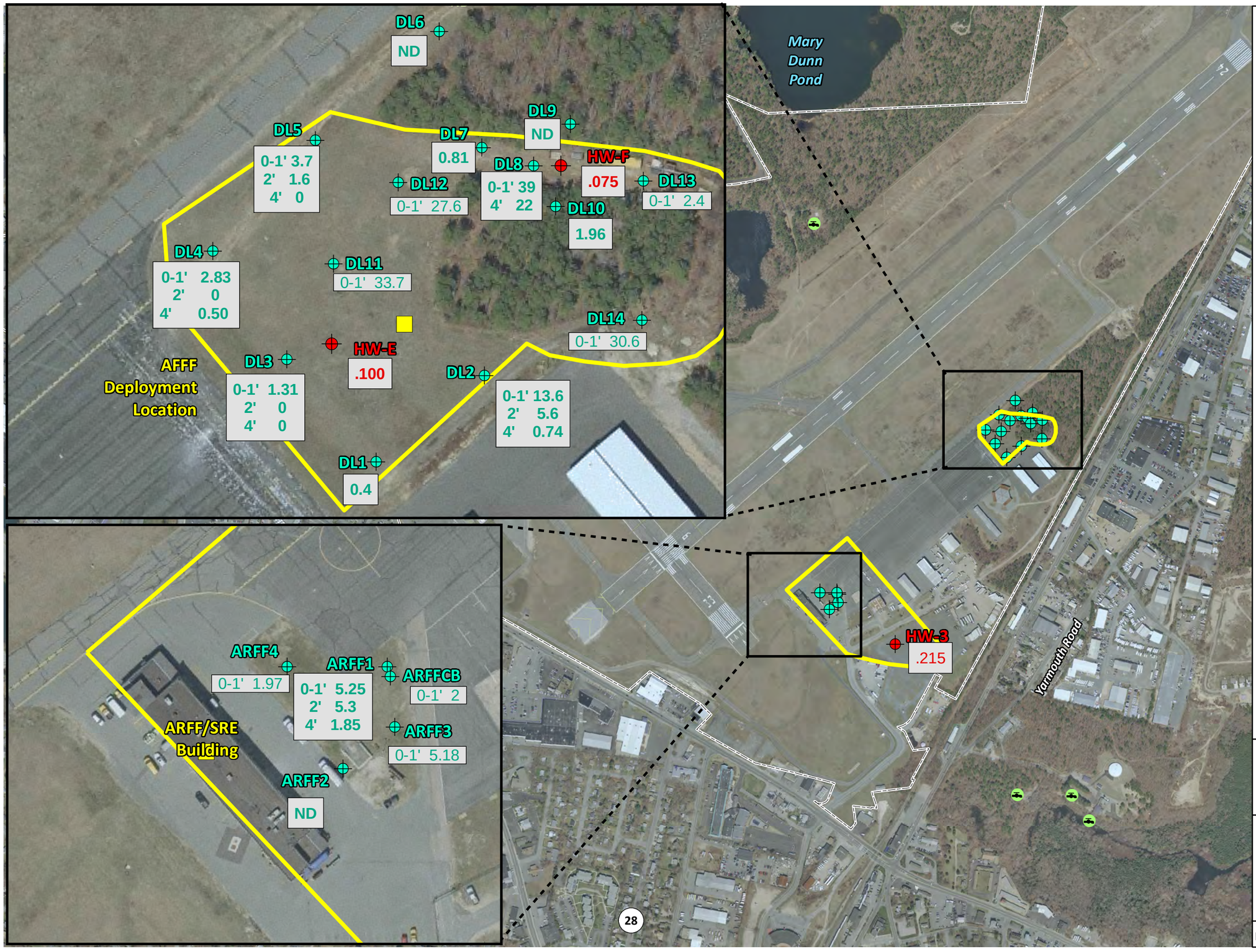

Legend

- Monitoring Wells
- PFOS/PFOA Soil Samples
- ND — No Detect
- * — Pending Laboratory Results
- ## — Soil Concentration (ug/kg PFOS+PFOA)
- ## — GW Concentration (ug/L PFOS+PFOA)
- Drinking Water Wells
- Barnstable Municipal Airport Property Boundary

N

0 750

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Results of Soil Analysis for the Deployment Area and ARFF Bldg.
Barnstable Municipal Airport
Hyannis, MA

Date: 4/17/2018

Figure 8

Path: H:\Projects\HYA\17027 BMA PFOS 1-4 IRA\GIS\Maps\170720_PFOS_SoilBorings_with_data.mxd

TABLES

Table 1. 1,4 Dioxane Groundwater Results

	GW-1	Date	HW-4D	HW-4M	HW-207D	HW-19D	HW-A(D)	HW-B(D)
1,4-Dioxane	0.3	4/5/2017	ND	ND	ND	ND	ND	ND
		Date		**OW-18M**	**OW-18D**	**OW-19D**	**OW-19M**	**OW-9DD**
1,4-Dioxane	0.3	4/11/2017		ND	**0.552**	**0.800**	ND	**0.838**

Notes:

ND= Not detected by method

ug/L = micrograms per liter

MDL = method detection limit

Table 2. PFAS in Soil at Deployment Area and ARFF Sites

	DL1(0-1') 6/20/2017	DL2 (0-1') 6/20/2017	DL2 2' 9/26/2017	DL2 4' 9/26/2017	DL3 (0-1') 6/20/2017	DL3 (0-1') LAB DUP 6/20/2017	DL3 2' 9/26/2017	DL3 4' 9/26/2017
Perfluorobutanesulfonic acid (PFBS)	0.17 ND	0.17 ND	0.17 ND	0.17 ND	0.17 ND	0.17 ND	0.17 ND	0.17 ND
Perfluoroheptanoic acid (PFHpA)	0.30J	1.9	1.2	0.48J	0.84J	0.79J	0.17 ND	0.17 ND
Perfluorohexanesulfonic acid (PFHxS)	0.23ND	1.8	0.74J	0.59J	0.34J	0.34J	0.23 ND	0.23 ND
Perfluorononanoic acid (PFNA)	0.17 ND	0.81J	2.5	0.17 ND	0.55J	0.51J	0.17 ND	0.17 ND
Perfluorooctane sulfonate (PFOS)	0.40J	12	1.5	0.21 ND	0.51J	0.45J	0.21 ND	0.21 ND
Perfluorooctanoic acid (PFOA)	0.26 (ND)	1.6	4.1	0.74J	0.80J	0.63J	0.26 ND	0.26 ND
PFOS+PFOA	0.40J	13.6	5.6	0.74	1.31	1.08	ND	ND
	DL4 (0-1') 6/20/2017	**DL4 2' 9/26/2017**	**DL4 4' 9/26/2017**	**DL5 (0-1') 6/20/2017**	**DL5 2' 9/26/2017**	**DL5 4' 9/26/2017**	**DL6 (0-1') 6/20/2017**	**DL7** (0-1') 6/20/2017**
Perfluorobutanesulfonic acid (PFBS)	0.17 ND	0.17 ND	0.17 ND	0.17 ND	0.17 ND	0.17 ND	0.17 ND	0.17 ND
Perfluoroheptanoic acid (PFHpA)	0.31J	0.17 ND	0.17 ND	2.5	0.40J	0.50J	5	2.5J
Perfluorohexanesulfonic acid (PFHxS)	0.23 ND	0.23 ND	0.23 ND	0.49J	0.49J	0.23 ND	0.23 ND	0.23 ND
Perfluorononanoic acid (PFNA)	2.7	0.17 ND	3.7	0.19J	0.17 ND	0.17 ND	0.19J	9.6J
Perfluorooctane sulfonate (PFOS)	2.0	0.21 ND	0.50J	0.21 ND	0.21 ND	0.21 ND	0.21 ND	3.9J
Perfluorooctanoic acid (PFOA)	0.83J	0.26 ND	0.26 ND	3.7	1.6	0.26 ND	0.26 ND	4.2J
PFOS+PFOA	2.83	ND	0.5	3.7	1.6	ND	ND	8.1
	DL8 (2') 6/20/2017**	**DL8** (4') 9/26/2017**	**DL9 (0-1') 6/20/2017**	**DL10 (0-1') 6/20/2017**	**DL 11 (0-1') 9/26/2017**	**DL12 (0-1') 9/26/2017**	**DL13 (0-1') 9/26/2017**	**DL14 (0-1') 9/26/2017**
Perfluorobutanesulfonic acid (PFBS)	0.17 ND	1.7 ND	1.7 ND	1.7 ND	0.17 ND	0.17 ND	0.17 ND	0.17 ND
Perfluoroheptanoic acid (PFHpA)	2.9J	4.7J	0.66J	1.3	2.1	1.2	1.6	4.9
Perfluorohexanesulfonic acid (PFHxS)	2.3 ND	2.3 ND	0.35J	0.94J	0.82J	0.23 ND	0.23 ND	0.71J
Perfluorononanoic acid (PFNA)	46	1.7 ND	0.22J	1.7 ND	16	7.3	1.5	10
Perfluorooctane sulfonate (PFOS)	14	2.1 ND	0.38J	0.26J	29	23	0.66J	7.6
Perfluorooctanoic acid (PFOA)	25	22	0.68J	1.7	4.7	4.6	2.4	23
PFOS+PFOA	39	22	1.06	1.96	33.7	27.6	3.06	30.6
	ARFF1 (0-1') 6/20/2017	**ARFF1 (2') 9/26/2017**	**ARFF1 (4') 9/26/2017**	**ARFF2 (0-1') 6/20/2017**	**ARFF3 (0-1') 9/26/2017**	**ARFF4 (0-1') 9/26/2017**	**ARFF4 (0-1') LAB DUP**	**ARFFCB (0-1) 9/26/2017**
Perfluorobutanesulfonic acid (PFBS)	0.17 ND	0.17 ND	0.17 ND	0.17 ND	0.17 ND	0.17 ND	NA	0.17 ND
Perfluoroheptanoic acid (PFHpA)	0.82J	1.8	0.66J	0.17 ND	0.60J	0.75J	NA	0.60J
Perfluorohexanesulfonic acid (PFHxS)	0.23 ND	0.23 ND	0.23 ND	0.23 ND	0.64J	0.23 ND	NA	0.23 ND
Perfluorononanoic acid (PFNA)	2.5	5.7	1.4	2.0J	0.91J	2.9	NA	0.17 ND
Perfluorooctane sulfonate (PFOS)	4.5	2.7	1.1	0.29J	4.4	1	NA	1.1
Perfluorooctanoic acid (PFOA)	0.75J	2.6	0.75J	0.26 ND	0.78J	0.97J	NA	0.90J
PFOS+PFOA	5.25	5.3	1.85	0.29	5.18	1.97	NA	2

*Sample diluted, Detection limits adjusted accordingly

J - Results between RDL and MDL

Results in ug/kg, micrograms per kilogram

ND= Not detected by method

MDL= method detection limit

Table 3. Groundwater Results for PFAS Compounds

	North Ramp							Lewis Pond		
	HW-1 7/1/2016	HW-1 6/20/2017	HW-4M 4/5/2017	HW-5 7/1/2016	HW-5 4/7/2017	HW-23 6/20/2017	HW-19D 6/20/2017	HW-D 4/7/2017	HW-401S 4/7/2017	HW-C 4/7/2017
Perfluorobutanesulfonic acid (PFBS)	0.009 ND	0.02	0.005J	0.009 ND	0.0048 ND	0.0051J	0.0081J	0.0048 ND	0.0048 ND	0.0048 ND
Perfluoroheptanoic acid (PFHpA)	0.01	0.0042J	0.007J	0.01	0.0084J	0.0045J	0.0052J	0.0033 ND	0.0043J	0.0033 ND
Perfluorohexanesulfonic acid (PFHxS)	0.018	0.065	0.02	0.018	0.018J	0.021	0.046	0.0089J	0.011J	0.0034 ND
Perfluorononanoic acid (PFNA)	0.002 ND	0.0057J	0.0046 ND	0.002 ND	0.0046 ND	0.0038 ND	0.0065J	0.0046 ND	0.0046 ND	0.0046 ND
Perfluorooctane sulfonate (PFOS)	0.017	**0.24**	0.043	0.017	0.052	0.0079J	0.061	0.022	0.012J	0.0026 ND
Perfluorooctanoic acid (PFOA)	0.033	0.022	0.011J	0.033	0.020J	0.0046 ND	0.017J	0.0046 ND	0.0046 ND	0.0046 ND
PFOS+PFOA	0.05	**0.262**	0.054	0.05	**0.072**	0.0079	**0.078**	0.022	0.012	ND

	Steamship Parking Lot						Airfield		Airport Road	
	HW-2 7/1/2016	HW-3 7/1/2016	HW-3 4/5/2017	HW-300 7/1/2016	HW-301 7/1/2016	HW-302 7/1/2016	HW-E 4/5/2017	HW-F 4/5/2017	HW-A 4/7/2017	HW-B 4/7/2017
Perfluorobutanesulfonic acid (PFBS)	0.009 ND	0.009 ND	0.0048 ND	0.009 ND	0.009 ND	0.009 ND	0.0048 ND	0.0048 ND	0.017J	0.0077J
Perfluoroheptanoic acid (PFHpA)	0.0071	0.016	0.1	0.0096	0.002	0.019	0.15	0.34	0.0048J	0.049
Perfluorohexanesulfonic acid (PFHxS)	0.0035	0.0043	0.020J	0.012	0.038	0.006.3	0.042	0.019J	0.0079J	0.044
Perfluorononanoic acid (PFNA)	.002 ND	0.0063	0.027	0.002 ND	0.002 ND	0.054	0.0087J	0.0046 ND	0.0046 ND	0.0046 ND
Perfluorooctane sulfonate (PFOS)	0.012	**0.084**	**0.15**	0.017	0.011	0.014	0.047	0.0026 ND	0.0026 ND	0.026
Perfluorooctanoic acid (PFOA)	0.0063	0.0091	0.065	0.0052	0.0037	0.033	0.053	**0.075**	0.0046 ND	0.0094J
PFOS+PFOA	0.0183	**0.0931**	**0.215**	0.0222	0.0147	0.047	**0.1**	**0.075**	ND	0.0354

	Maher Wells									Surface Water
	OW-9S 7/5/2016	OW-9D 7/5/2016	OW-9D 4/11/2017	OW-18S 7/5/2016	OW-18M 7/5/2016	OW-18D 7/5/2016	OW-18D 4/11/2017	OW-18D Duplicate 7/5/2016	OW-19D 4/11/2017	Kmart 6/20/2017
Perfluorobutanesulfonic acid (PFBS)	0.009 ND	0.009 ND	0.0048 ND	0.009 ND	0.009 ND	0.009 ND	0.016J	0.009 ND	0.0055J	0.00.8 ND
Perfluoroheptanoic acid (PFHpA)	0.014	0.0028	0.034	0.00.1	0.0029	0.0071	0.015J	0.0063	0.0051J	0.0033 ND
Perfluorohexanesulfonic acid (PFHxS)	03 (ND)	0.012	0.12	0.0068	0.016	0.01	0.13	0.011	0.029	0.0034 ND
Perfluorononanoic acid (PFNA)	0.0077	0.0036	0.059	0.002 ND	0.0076	0.0065	0.0046 ND	0.0058	0.006J	0.0043 (NA)
Perfluorooctane sulfonate (PFOS)	0.0074	0.041	**0.5**	0.0083	0.044	0.018	**0.22**	0.019	0.029	0.0026 ND
Perfluorooctanoic acid (PFOA)	0.007	0.0052	0.055	0.018	0.0058	0.0059	0.025	0.0059	0.0046 ND	0.0046 ND
PFOS+PFOA	0.0144	0.0462	**0.555**	0.0263	0.0498	0.0239	**0.245**	0.0249	0.029	ND

J= Results between RDL and MDL

Results in ug/L, mmicrograms per liter

ND= Not detected by method

MDL= method detection limit

Shaded/ Bold results above DEP GW-1 standard (0.07 ug/L)

Table 5. PFAS Results for Background Soil Samples

Sampling Date: 10/26/2017

	BG-1 (Phinneys Lane Power Lines)	**BG-2** (SE of RW 33 Approach Safety Zone)	**BG-3** (1000ft from RW 24 Approach - N side)	**BG-4** (1000ft from RW 24 Approach - S side)	**BG-5** (100ft N of bldg @ RW 24 Approach)	**BG-6** (1500ft NW of RW 15 Approach)	**BG-7** (SW Corner of RW6/33 Intersection)	**BG-8** (SE Corner of RW 6/33 Intersection)	**BG-9** (Yarmouth Rd/Old Yarmouth Rd INT)	**BG-10** (Grass Lot S of Rotary)
Perfluorobutanesulfonic acid (PFBS)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Perfluoroheptanoic acid (PFHpA)	ND	ND	0.18J	ND	0.18J	ND	ND	0.23J	ND	ND
Perfluorohexanesulfonic acid (PFHxS)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Perfluorononanoic acid (PFNA)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Perfluorooctane sulfonate (PFOS)	ND	0.7	0.38	2.3	0.41	0.32J	.33J	0.31J	1.3	0.62J
Perfluorooctanoic acid (PFOA)	0.58J	ND	ND	ND	0.47J	ND	ND	ND	ND	ND
PFOS+PFOA	0.58	0.7	0.38	2.3	0.88	0.32	0.33	0.31	1.3	0.62

Sampling Date: 12/14/2017

	BG-11 (Popplebottom Trail - 100' RT)	**BG-12** (Oak St/Old Stage Triangle)	**BG-13** (Osterville Comm. Center)	**BG-14** (Barnstable Senior Center)	**BG-15** (West End Rotary)	**BG-16** (Town Green - at stage)	**BG-17** (Veterans Memorial Park)	**BG-18** (Aselton Park)	**BG-19** (Hathaways Pond Parking lot green)	**BG-20** (The Hollow - Barnstable Village)
Perfluorobutanesulfonic acid (PFBS)	ND	ND	ND	ND	ND	0.30 J	ND	ND	ND	ND
Perfluoroheptanoic acid (PFHpA)	ND	ND	ND	ND	0.44J	ND	ND	0.35J	ND	0.46J
Perfluorohexanesulfonic acid (PFHxS)	ND	0.39J	ND	ND	0.57J	0.47J	ND	0.49J	ND	ND
Perfluorononanoic acid (PFNA)	ND	0.41J	ND	ND	0.53J	ND	0.67J	0.41J	ND	ND
Perfluorooctane sulfonate (PFOS)	0.41J	0.76J	0.99J	ND	3.1	2	0.36J	2.3	0.41J	0.44J
Perfluorooctanoic acid (PFOA)	0.75J	0.67J	0.33J	ND	0.46J	0.37J	0.36J	0.50J	ND	0.86J
PFOS+PFOA	1.16	1.43	1.32	ND	3.56	2.37	0.72	2.8	0.41	1.3

Results in ug/kg = micrograms per kilogram

Maxxim Laboratory analysis

ND - not detected at laboratory detection limit

J = result between RDL and MDL

Table 4. PFAS and SPLP Leaching Analysis Results

	DL4 4' 9/26/2017	DL5 2' 9/26/2017	DL8** (4') 9/26/2017	DL14 (0-1') 9/26/2017	Stockpile East 10/10/2017	Stockpile West 10/10/2017
Perfluorobutanesulfonic acid (PFBS)	ND	ND	ND	ND	ND	ND
Perfluoroheptanoic acid (PFHpA)	ND	0.40J	4.7J	4.9	ND	ND
Perfluorohexanesulfonic acid (PFHxS)	ND	0.49J	ND	0.71J	ND	ND
Perfluorononanoic acid (PFNA)	3.7	ND	ND	10	ND	ND
Perfluorooctane sulfonate (PFOS)	0.50J	ND	ND	7.6	0.39J	0.38J
Perfluorooctanoic acid (PFOA)	ND	1.6	22	23	ND	ND
PFOS+PFOA	0.5	1.6	22	30.6	0.39	0.38
Leachable Perfluorobutanesulfonic acid (PFBS)	ND	ND	ND	ND	ND	ND
Leachable Perfluoroheptanoic acid (PFHpA)	ND	ND	0.065J	0.17	ND	ND
Leachable Perfluorohexanesulfonic acid (PFHxS	ND	ND	ND	0.010J	ND	ND
Leachable Perfluorononanoic acid (PFNA)	0.16	ND	0.052J	0.37	ND	ND
Leachable Perfluorooctane sulfonate (PFOS)	0.013J	0.042	ND	0.19	ND	ND
Leachable Perfluorooctanoic acid (PFOA)	0.012J	ND	0.6	0.87	ND	ND
Leachable PFOS+PFOA	0.025	0.042	0.6	1.06	ND	ND

**Sample diluted, Detection limits adjusted accordingly

Results in ug/kg = micrograms per kilogram

Maxxim Laboratory analysis

ND - not detected at laboratory detection limit

J = result between RDL and MDL